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A PROBLEM IN RAILWAY OPERATION SUCCESSFULLY SOLVED.

Every one remembers the old schoolboy puzzle of finding a method by which two trains going in opposite directions on a single-track road might pass by means of a switch which was shorter than either train. Probably few of us ever imagine that questions of this kind really come up in actual railway operation, but one did occur recently at a terminal station of one of the Brooklyn elevated railroads, and was very prettily solved in the presence of a platform full of impatient passengers.

At this station, after some waiting, three trains drew in, one after the other; and after shifting them about, apparently with the idea of changing their positions by means of a switchback no longer than any one of the trains, and which already contained a number of empty cars, the difficulty was got over in the following way: Two of the trains were first sent out empty, and the passengers crowded into the last one, which was held back to get on schedule time. There may have been some grumbling at this ingenious solution, but most of those who got aboard doubtless were grateful for being allowed to take the third train, and not being forced to wait for the sixth or ninth.

PROBLEMS IN THE EDUCATION OF ENGINEERS.

There has been of late a noteworthy awakening of interest in engineering education. For the past six months this subject has been undergoing a lively discussion in England and many and widely different views have been put forward and warmly defended both by instructors in the technical schools and engineers and manufacturers engaged in active business. In Germany as well, this most important problem has received attention and quite recently in this country a series of papers was read at the annual convention of the American Institute of Electrical Engineers, which touched upon certain phases of the problem and which should be of assistance to the technical schools not only in the suggestions offered but in awakening the interest and cooperation of the practising engineers.

Society for the Promotion of Engineering Education.

Some years ago the Society for the Promotion of Engineering Education was organized for the purpose of taking up and discussing problems relating to the education of engineers. This society meets annually and discusses reports prepared by special committees and papers prepared by members. This year the society held a joint session with the American Electrical Institute when the papers referred to above were presented, together with others from members of this society. While nearly all the members of this society are engaged in giving instruction in technical schools, most of them are themselves graduates of technical schools, and many of them are practising engineers, in addition to their work at some technical school. This society has done and is now doing work of the greatest value. Its members realize, as probably do few others, the difficulties met in laying out a satisfactory course of instruction in any branch of applied science.

The Question of Time.

One of the first to be met, and at the same time one of the most serious problems is the proper distribution of time to the various subjects required. Probably few engineers who have not at some time or other had to do with the planning of some branch of engineering instruction realize how rigidly the limits are set, and that it is impossible to introduce a new subject without dropping an old one to set free the required time. To illustrate this point: At nearly all of the technical schools a student is expected to spend from fifteen to twenty hours in the classroom every week. If outside preparation is required he is expected to give two hours' time to every hour in the classroom. In laboratory and shop work about three hours are assumed to be equivalent to one in the classroom. This gives the student from forty-five to fifty-four hours per week actual work. The instructor is supposed to allot to the various subjects which must be covered by the student a suitable proportion of this time. But it probably never happens that he gives to any one subject as much time as he thinks that subject really should have.

Four Crowded Years.

It must not be thought that the usual four years given to engineering courses can be devoted entirely to instruction in purely technical subjects. The student is taken from high school and about half this time is required in laying the foundation for his technical studies. Throughout the entire four years there is a constant demand upon the head of the department to allow more time, not only for the strictly technical subjects but for all the preparatory subjects.

The head of a department can not add to the work as he desires, because any new work can only be given at the expense of other courses; and it is a difficult mat-

ter to decide on what part of the old course shall be omitted to make way for the new.

For a number of years past certain prominent technical instructors have held that an engineering course should be preceded by a general college course. This same idea was suggested at the recent meeting. While, in many ways, this would seem to offer the best solution, there is a very serious objection to it. Only recently certain gentlemen prominent in educational work stated that the four-year college course is too long, because the graduate does not get to work soon enough—that three years should be ample, and the student should be at work by the time he is eighteen, instead of not until he is twenty-one or twenty-two, as is now usually the case. To add two post-graduate years to a four-year college course would keep the young engineer that much longer away from active work, and for that reason be undesirable.

ELECTRIC TRUCKS.

The ease with which electric motors may be controlled has been an important factor in bringing about the use of this means of driving machinery, in many instances, irrespective of the actual cost of the power thus employed. These same advantages are appreciated by the builders of automobiles and power trucks, and as a result we find the electric truck growing in popularity where the conditions are such that there is no difficulty in keeping its battery charged.

Electric Driving of Four Wheels.

One of the advantages which has been made use of in building electric trucks is the ability to drive two wheels of the truck without the use of a differential gear. More recently this method of driving has been extended and there is to-day a large power truck being put out in which all four wheels are driven by independent motors.

But the use of electricity has not stopped when all the running wheels are driven, for these large trucks are now equipped with a small motor for steering. This steering motor, in addition to its use for this purpose, is also adapted to drive the windlass of the truck which is used for loading and unloading. Further, these large trucks are equipped with an automatic brake electrically controlled. These devices equip a truck as completely as a steamship. No manual work is required of the driver; all the latter is called upon to do is to direct the work of the truck.

A GROWING INDUSTRY.

A statistical report issued by the Census Bureau of the United States shows the extent of the growth of the electric railway industry. There were in 1902 in the United States 987 companies operating street and electric railways and controlling 22,577 miles of single track.

Increase in Mileage and Passengers.

The single-track mileage increased from 8,123 miles in 1890 to the figure given above in 1902, an increase of 177.94 per cent. The number of fare passengers carried increased from 2,023,010,202 in 1890 to 4,809,554,438 or 137.74 per cent. The report further states that the increase in the length of track is confined entirely to the roads operated by electric power.

What the Report Shows.

An interesting fact is shown by these figures. The increase in mileage was considerably more than the increase in passengers carried, and further, as the report shows, that the cost of construction increased 456.7 per cent. No doubt the great increase of cost of construction, as indicated by this figure, is due to the more substantial character of the work and the greater restrictions imposed upon urban roads, as well as the increase in the price of labor and material. But it is well to call attention to the fact that while the cost of construction increased over four and one-half times and the length of roads increased over one and three-quarters times, the increase in passengers carried was only a little more than one and one-third times. Either the early roads must have been quite profitable and the companies to-day are satisfied with a smaller profit, or a good number of these railways can hardly be considered profitable investments.

Too Much Road Building.

Electric railway construction is probably the most active of all the industrial applications of electricity, and for this reason also, as well as the conditions indicated by the census figures, it would seem wise to make haste slowly in planning and building new lines. While the greater number of these roads were necessary and while there is still a crying need in certain localities for better transportation facilities, many of the lines were merely speculations, built to be sold.

AN ATTRACTIVE SCHEME.

Some time since we took occasion to comment upon a scheme for an electromagnetic railway which is being put forward in New York. Since then another glowing description has been published in a daily paper, from which we take the following new and interesting announcements.

Two Important Principles.

Since the train will be lifted from the rails by magnets suspended below the iron structure, and pulling upward, it is said that the expense of the iron structure will be only one-sixth of what would otherwise be required, the structure being relieved of the greater part of the weight. It has also been discovered by the inventor of this system that less power is required to magnetize his lifting magnets when they are in motion than when they are standing still, "because the first pole induces its pole and, sliding by, leaves it for the second pole coming up; therefore, as the magnet slides along, it has to induce but one pole, while if it remains stationary it needs enough charge to induce two poles at one time." The unimportant fact, that is to say, unimportant so far as this scheme is concerned, that a north pole will induce in the iron opposite it a south pole which would tend to repel the following south pole, is not worthy of consideration by the inventor of this system.

A Minor Improvement Suggested.

The description referred to above is illustrated by a number of photographs of the model of the car and drawings of the proposed train. While not endorsing this scheme at all, we venture to suggest that the locomotive shown in one of the drawings—which, by the way, is to be equipped with a ten-horse-power motor and to make a speed of three hundred miles an hour—would give better results if magnets were placed above the iron-work, so that they would pull down, instead of being placed below, as in this position they will lift the driving-wheels off the rail.

Practical Telephone Engineering—II.

By William W. Handy.[1]

AFTER the general design of a telephone plant has been determined upon, including the location of the exchanges and the selection of the proper equipments for the same, the next problems presented to the engineer are the design of the cable and subway systems, the location of the pole lines and the distribution of subscribers' wiring.

In the following article we will take as an example the city illustrated in Fig. 4, showing the exchanges located at the points *a*, *b* and *c*, these locations having been selected as described in the previous article on this subject. The exchange districts to be supplied from the respective exchanges *a*, *b* and *c* are enclosed by the dotted lines as shown.

FIG. 4.—LAYING OUT A TELEPHONE SYSTEM FOR A CITY WITH 9,500 SUBSCRIBERS.

GENERAL DESIGN OF DISTRIBUTING SYSTEM.

The subway system, being the most costly part of the outside construction, should be very carefully laid out. In all large cities there is a certain district in which the laws of the city require that only underground subway construction can be used, but the installation of distributing poles in this district for the purpose of distributing subscribers' wires from the subway to the telephone is generally allowed. In some cities, however, this method is not permitted, and in such cases it is necessary to provide some other means of distributing to subscribers.

In place of the distributing poles it is common practice to install cable terminals either in the subway manholes in the streets or on the walls of buildings, and distribute the subscribers' wiring from these terminals along the rear walls of buildings to the telephone instruments. This is an expensive style of construction, and is generally avoided if possible, and in the present example we will assume that the distribution in the subway district is made from distributing poles, except in the congested business district where the cables from the subway may be brought directly into certain buildings to a terminal, and the subscribers' wires distributed from this terminal to the telephone instruments.

For the plant under consideration we will assume that the largest cables to be installed are 200-pair, the other sizes being 175, 150, 125, 100, 75, and 25-pair. Modern practice tends toward the use of still larger cables, as high as 350-pair, the object of using these large sizes being to decrease the cost of both the cable and subway systems. In order to lay out the cable system properly it is necessary to indicate in figures on a map of the city the number of prospective subscribers in each block, and then put in sufficient cables to not only distribute to these subscribers, but also to allow for a reasonable increase in their number. Sometimes it is advisable in certain districts to install cables having as much as fifty per cent greater capacity than required at the time the cables are installed, and in other districts it is not necessary to allow for such a large increase. Generally in the business district of a city a large cable capacity should be installed. To illustrate this, we will take for an example an office building or block with several office buildings in it, the number of subscribers being about 125. We could put in a 150-pair cable sufficiently large for the immediate requirements, but the number of subscribers is likely to increase in a year to, say, 175, and it would be necessary then to install a second cable of about seventy-five-pair capacity. These two cables, one having 125 pairs and the other seventy-five pairs, would cost more

[1 The first article of this series by Mr. Handy appeared in the ELECTRICAL REVIEW for June 20, No. 25, vol. xlii.—ED.]

than one 200-pair cable, and it would therefore be best to install a 200-pair cable at first. For this and other reasons all the cables leaving the main exchange should be 200-pair, the size of any cable decreasing until the last distributing terminal connected to the cable is reached. The branch cables to the terminals should be multiplied with each other, that is, some of the pairs of wires connected to one terminal should also be connected to several other terminals in the immediate vicinity, as subscribers connected to a certain terminal may move, thus leaving a number of wires at the terminal out of use, which wires if they were multiplied to some other terminal could be used again. This plan has been found very economical, as it decreases the chances of having a large part of the cable system out of use, and often avoids the necessity of installing additional cables.

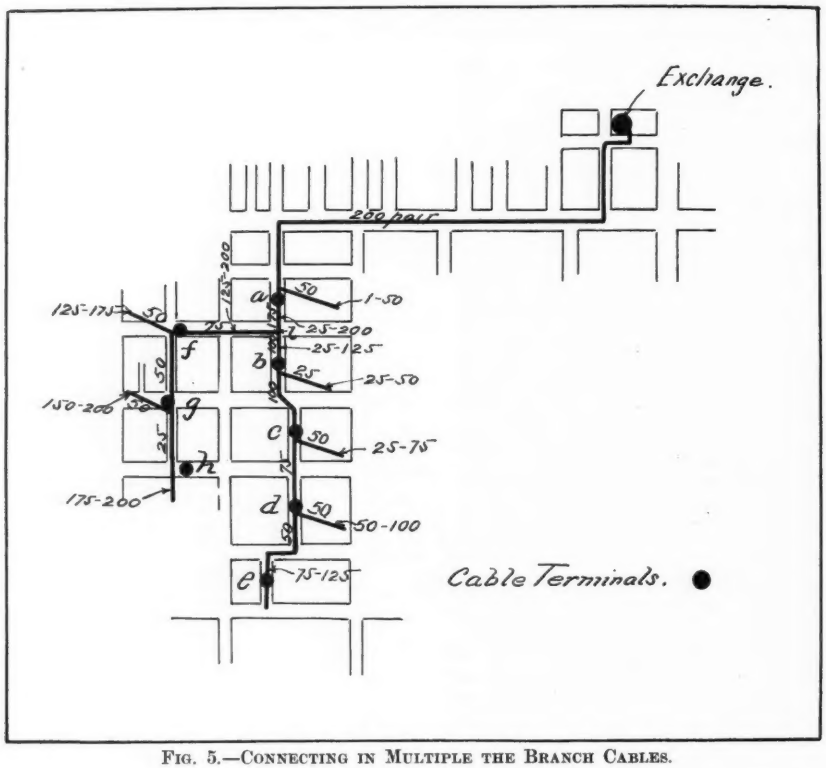


FIG. 5.—CONNECTING IN MULTIPLE THE BRANCH CABLES.

This system of connecting in multiple the branch cables is illustrated in Fig. 5. A 200-pair cable coming from the exchange has eight branch cables of the sizes shown, these branch cables supplying the terminals *a, b, c, d, e, f, g* and *h*. A fifty-pair branch containing pairs one to fifty is spliced to the 200-pair cable and carried to the terminal *a*, from this splice a 175-pair cable containing pairs 25 to 200 runs to the point *i*, and here the cable divides as shown into a 100-pair cable having pairs 25 to 125 and a seventy-five-pair cable having pairs 125 to 200. A twenty-five-pair branch containing pairs twenty-five to fifty runs to terminal *b*, and these pairs are also multiplied to terminal *c* by means of a fifty-pair branch containing pairs twenty-five to seventy-five. Thus pairs twenty-five to fifty are multiplied to three terminals, and may be used at either of them if not in use at the others. The other branch cables are as shown in the figure, and need no further explanation. There are a number of methods of multiple cable distribution, some of them quite complicated, but the above illustrates the matter quite clearly, and is a simple method and causes no complication either in the splicing or tracing out of circuits.

Referring to Fig. 4, there are 3,650 subscribers to be supplied from exchange *a*, and the subway and pole lines must be located so as to distribute to these subscribers in the most economical manner. We will assume that there are twenty-four 200-pair cables connected to exchange *a*, all of these cables entering the subway from the exchange, and most of them distributing to subscribers from terminals located in buildings and from distributing poles. A few of these cables, however, are to be carried through the subway to pole lines outside of the subway district, and are there to be connected to terminals and carried to the subscribers' telephones by separate wires. From exchange *b* there are, we will assume, twelve 200-pair cables distributing to the subscribers in this district. Most of the subscribers in district *b* are reached by pole lines, and the 200-pair should be split up into 100-pair or smaller where they are run on poles, as the larger cables make clumsy and rather costly construction due to their weight. From exchange *c* we will assume there are four 200-pair cables supplying subscribers in this district, most of these cables being supported on poles and they should therefore be divided up into smaller sizes.

In addition to the cables for distribution to subscribers, there should also be installed trunking cables approximately as follows: Between the two large exchanges *a* and *b* there should be a trunking cable capacity of about 200-pair, between exchanges *a* and *c*, a trunking cable capacity of about 100-pair, and between exchanges *b* and *c*, a trunking cable capacity of about fifty-pair.

The subway system and pole lines finally selected for this plant, we will assume, are as shown in Fig. 4. All that part of the city included in the subway district is supplied directly from the conduit lines, the cables either running to distributing poles located as near the manholes as possible and not over 200 feet from them, or to terminals located in buildings; the latter method being adopted for those streets in the congested business districts where there are a very large number of subscribers. From terminals located in buildings the wiring should be carried through the vaults of adjoining buildings to the subscribers located in the block where the terminals are placed. This makes a very satisfactory system of distribution, although, in some cases, the construction is expensive, and it often is necessary to furnish a free telephone for the privilege of distributing wires through the vaults of certain buildings to other adjoining buildings. It will be noticed from Fig. 4 that some of the subway lines are extended outside of the subway district; two of these lines are those connecting the exchanges *b* and *c* with the main exchange *a*, through which lines the trunking cables are carried. It is always advisable to have these trunking cables underground, as they are very important for the successful operation of the plant, and they should therefore be installed where they are not likely to be injured from external causes. There are also one or two other conduit lines extending beyond the subway district, and the reason for this is that the number of cables to be carried through them is quite large, these cables being too heavy to support

satisfactorily on single-pole lines. From a first glance at Fig. 4, it looks as if a conduit should be run along the street marked Ave. A, instead of two lines, on the streets east and west of it as shown. We will assume that the reason for this is that Ave. A is paved with asphalt, and the other streets with a paving sufficiently less costly than asphalt to warrant installing two lines on these streets instead of one line on Ave. A. For reasons similar to the above and also due to present subsurface construction, it is often necessary to install the conduit lines on streets which are not very well located for distribution.

The pole lines, as shown, are laid out in as economical a manner as possible to reach the subscribers outside of the subway district. Very often in telephone plant construction the location of pole lines is one of the most difficult problems encountered, due generally to the great number of pole lines already installed on the streets. It is generally not advisable and often not permitted by cities to put up more than two pole lines on one street, and sometimes only one line is allowed. To overcome this, it is often necessary to either put in a conduit line or to run two pole lines in alleys or streets adjoining the one selected as best adapted to distribution.

In selecting the number of ducts for the conduit lines, ample provision must be made for increase of cable capacity, and also for the possibility of some of the ducts getting out of line or clogged up, and therefore unfit for use. For the plant under consideration we must install a conduit entering exchange *a*, having a capacity sufficient for twenty-four 200-pair cables. This line should have about fifty ducts or more, the other smaller and branch lines a capacity in at least the same proportion of ducts to cables, and in very small lines having only one or two cables the ducts should be not less than four in number. The connections to distributing poles and buildings should generally be of three-inch wrought-iron pipe, or some suitable form of tubing, and if there is any chance of more than one cable being installed there should be two pipes and often more.

In estimating on the above plant, we will assume the following:

EXCHANGE EQUIPMENT.

Three exchanges, one of 4,320 immediate and 6,000 ultimate capacity, one of 1,920 immediate and 2,880 ultimate capacity, and one of 720 immediate and 1,120 ultimate capacity, making a total immediate capacity of 6,960 lines and total ultimate capacity of 10,000 lines for 5,900 subscribers.

SUBWAY.

	Feet.
Lineal feet of trench	45,000
Duct feet of conduit	360,000
Lateral connections from subway	15,000

POLE LINES.

Number of poles required	5,000

DISTRIBUTING POLES.

Number required	300

UNDERGROUND AND AERIAL CABLES.

	Feet.
200-pair	90,000
175-pair	16,000
150-pair	20,000
125-pair	8,000
100-pair	13,000
75-pair	19,000
50-pair	29,000
25-pair	30,000

A Technical Institute for London.

A number of the large business houses of London have offered to London, through Lord Rosebery, the means for providing higher technical education. The idea is to supply London with a technical college, after the lines of the world renowned polytechnic at Charlottenburg. It is not for teaching the elements of this or that science; but after the foundation of a thorough education has been laid, the student can go there for the building up of the superstructure. The offer made by Lord Rosebery to the County Council is one of £300,000 ($1,500,000), one-third of this being subscribed by Messrs. Wernher, Beit & Company. The County Council is asked to contribute £20,000 ($100,000) a year for the maintenance of the institute. Lord Rosebery has agreed to act as the first chairman of the trustees, but definite plans for the organization have not yet been drawn up.

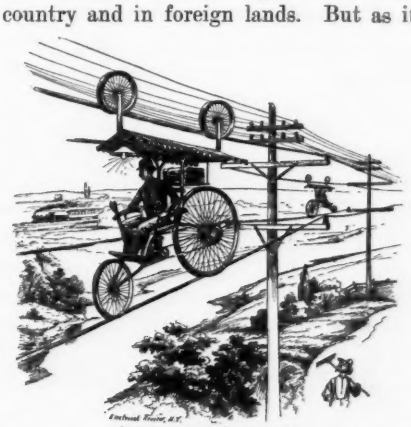
It has been suggested to organize this institute in connection with the Bessemer memorial scheme. At a meeting held to consider the plans for the latter undertaking, the following statement was made: "The establishment of completely equipped metallurgical teaching and research works should form the first object of the memorial for which the practical cooperation and financial aid of the industrial world are asked. The primary aim will be the thorough technical instruction of mining and metallurgical students. Metallurgical tests and research of all kinds for which facilities are not available in Birmingham or Sheffield will be carried out at this works on a practical scale by engineers and others. In this way advanced students will be afforded opportunities for the acquirement of practical knowledge and for original research which it would be difficult to obtain in any other way. The second object of the memorial will be a system of grants in the form of scholarships for post-graduate courses in specialized practical work in London and the great metallurgical centres."

Suspended Electric Railway.

TO THE EDITOR OF THE ELECTRICAL REVIEW:

In the tri-weekly New York *Tribune* of June 29 ult., is a picture of a "suspended railway in Germany," that in principle is exactly the same as the "electric air-line transportation," beautifully illustrated in the ELECTRICAL REVIEW of January 4, 1890.

You must be fully aware that this invention of mine has been encroached upon in a hundred different ways, both in this country and in foreign lands. But as it



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was tendered in the cause of science, I can not be very serious with my complaints, still I must fall upon your excellent journal to maintain my priority.

G. P. HACHENBERG, M. D.

Austin, Tex., July 4, 1903.

[The accompanying illustration has been reproduced from the ELECTRICAL REVIEW of the above date. This drawing was made by R. F. Outcault from Dr. Hachenberg's explanation of his idea. The suspended railway recently opened in Germany differs, of course, from the doctor's scheme in a few essentials, but, as he says, the principle is the same. We are glad to support his priority, although we can not understand why the traveler burned his electric lamp in the daytime. This is probably the cause for the surprise of the farmer in the lower right-hand corner.—ED.]

ELECTRICAL CONDITIONS IN INDIA.

BY ARTHUR C. HOBBLE.

During recent years British engineers have been active in promulgating civil and mechanical engineering projects throughout India. In one way this is evidenced by the number of miles of railroad which have been constructed and are at the present time in process of construction. Several universities and colleges in India afford instruction in all the branches of engineering with the exception of electrical engineering. This fact, in itself, is sufficient to demonstrate the lack of interest in electrical problems and causes the engineer who is lacking in knowledge of existing conditions in India to enquire why electrical engineering projects have not kept pace with other engineering enterprises?

There are general conditions which have in the past tended to discourage all engineering undertakings. These conditions have to a great extent been overcome, but not without much patience and perseverance on the part of those actively engaged in the execution of said undertakings.

Before any public enterprise (whether it be engineering or otherwise), involving a considerable sum of money, can be carried out plans must first be submitted to the home government for approval. It is extremely difficult for representatives of any foreign country other than England to engage in engineering or other enterprises in India without the payment of a heavy royalty.

Three-fourths of the population of India consist of the poorer, uneducated class of natives who have little or no ambition above their present state and who would interfere with, rather than promote, new methods and enterprises. The strict adherence of the natives to caste relations has caused no little annoyance in past, but to a great extent this difficulty has been overcome by convincing them of the fallacy of some of their ideas.

One of the most important factors to be considered under the general causes tending to discourage many engineering projects is the low wage rate. Some might unknowingly consider this an advantage, but it is well to remember that we have here to deal with unskilled labor. One white person can do as much work, and do it better, ordinarily, than several coolies. The common native laborer or coolie receives four or five annas (eight or ten cents) per day. In many cases power must be very cheap and machinery very efficient to compete with this factor. It is seldom that we find both of these conditions existing at the same time in any particular installation, but in such places as favor hydroelectric development of power both conditions may exist.

During the last few years many fan motors and "punkah pulling" motors have been imported from England and America, and there continues an increasing demand for the same. This seems at first strange in face of the fact that a native may be employed to pull a punkah all day for a trifling sum much less than the cost of power to operate the motors. The old Indian resident, however, smilingly tells us that "Swibo" goes to sleep during the night, or whenever he gets a chance, allowing his master to swelter while the electric motor runs keeping him cool as long as there is power to operate it. Here, then, we have a case in which the high efficiency of the motor more than offsets the low cost of man power.

There are specific conditions, however, tending to discourage electrical development. These conditions have been ameliorated somewhat, but only during the last three or four years, to any noticeable extent. As was stated in the beginning, there has been evident a lack of interest along electrical lines. Students have not had the opportunity of studying electrical engineering, because the colleges of India have offered no such course of training—and why?—simply because there has been no demand for electrical engineers on account of the slow development, or, we might say, non-development, of electrical projects. It is good to be able to state, however, that the University of Madras is contemplating the addition of such a course during the coming year.

It is only within recent years that long-distance power transmission at high voltages has been undertaken by leading nations. Hence it is not surprising that India has been slow to launch forth into this comparatively new departure of electrical engineering, even though the country possesses natural resources favoring such development. No doubt engineers have been aware of these resources favoring hydroelectric development, but more than mere capital and means for the utilization of such power was needing in the face of the discouraging conditions to be overcome.

In July, 1902, was completed the largest hydroelectric installation in the British Empire. The entire project, owned and controlled by the Mysore Government, is known as the "Cauvery Power Scheme." The General Electric Company, of America, was awarded the contract for the installation of the plant and assumed responsibility for the successful operation of the same until March 15, 1903, when it was turned over to the Mysore Government. The generating station is located at Sivasamudram, Mysore Province, where the Cauvery River affords a fall of some 400 feet. About 5,000 horse-power is transmitted at 30,000 volts over a distance of ninety-two miles to the Kolar gold fields, where it is utilized among the several mines for operating motor-driven air compressors, stone crushers, hoists and stamping mills. So successful has been the operation of this entire installation that the gold mines are demanding double the amount of power which the plant now affords. During the coming year this demand is to be complied with as the output of the generating station at Sivasamudram is to be almost doubled. It is unfortunate that the minimum flow of the Cauvery River during the extreme dry season of the year makes available only about 12,000 horse-power. The successful development of the Cauvery Power Scheme has awakened great interest throughout India and has opened the way for future developments along this line. In fact, several like projects are already being considered in other parts of the country. The engineers and all concerned in carrying out the Cauvery Power Scheme deserve much credit not only for the success which has attended their efforts in the face of discouragements, but because they have paved the way for greater developments in this line and have placed confidence in the place of scepticism.

The cost of distribution of electric light and power in the large cities has prohibited the installation of large central power stations in most cases, and small isolated plants are being installed for lighting many public buildings and private residences. A few of the large cities possess cotton mills which could no doubt employ electric drive with a saving in cost over present methods. However, there is another factor which must be considered especially when steam is the source of motive power. Though the coal mines of India can supply that product at approximately $7 per ton, it must be remembered that the coal of India possesses but about sixty per cent of the calorific value of coal imported from England. Considering this, together with the cost of transportation of machinery from England or America, it is not surprising that manufacturing concerns are slow in equipping their es-

tablishments with the latest and most approved methods.

Owing to the great variation of rainfall in different sections of India, the power, which any river may be capable of supplying during different seasons of the year, may vary from several thousand to several hundred thousand horse-power. A good example of this is the Cauvery River which furnishes the power for the generating station at Sivasamudram. During the extreme dry season of the year, about April or May, the river is capable of supplying in the neighborhood of 12,000 horse-power. During the rainy season, however, it may be capable of supplying 200,000 or 300,000 horse-power at times. The annual rainfall in India varies from about twenty-five inches in some sections to 200 inches in others. This great variation necessitates careful measurements and conservative calculations of available water power before considering seriously any hydroelectric project.

After a careful résumé of all conditions affecting electrical development in India, it may be safely stated, in conclusion, that the outlook is none but favorable for hydroelectric projects. The problem in most cases is not the lack of natural resources, but the lack of industries in the proper place to utilize the power. There is an increasing demand for small apparatus for isolated plants, and the invincible fan motor is finding its way in increasing numbers to India's tropical shores.

The German Government has erected a new lighthouse on the island of Heligoland, which will supplant the old petroleum lamp that has long directed the commerce at the mouth of the Elbe. It is claimed for this light that it is one of the most powerful in operation. The distinguishing feature is the return that has been made to the old form of parabolic reflector, with a powerful illuminant in the focus, in place of the Fresnel lenses and prisms. The mirror in this case is of glass, seventy-five centimetres in diameter, and silvered at the back. An arc light with a current of thirty-four amperes is the illuminant. The positive pole of the carbon is so near the focus that it is estimated that the beam is not more than two degrees in diameter, and its candle-power is quoted as 30,000,000. No protection against weather is provided in front of the light, and it is asserted that none is needed. Three similar mirrors and lamps are mounted in one plane round an axis, and the whole revolves four times in a minute, so that a flash is given every five seconds. A fourth mirror and lamp are provided in case of necessity, which will turn three times as rapidly, but it is not proposed to use this except in case of emergency. The duration of the flash is only one-tenth of a second.—*Nature*.

IMPROVEMENTS IN ELECTRIC TRACK WELDING.

BY GEORGE E. WALSH.

During the past year a number of improvements have been made in electrical track welding which, in view of the costly extension of railroad lines contemplated and the relaying of old tracks with new rails, is of the utmost importance. By the old method of track welding the number of breakages of rails was quite formidable in the course of a year; but with the modern improved electric welding system not one in a thousand of the joints shows breakage or loosening. The only weakness in the modern system was found at the bolt or bond-holes beyond the bars, and this has been remedied now by making the weld longer to cover the holes. The result of this has been that continuous rail joints are made which are as strong as the rail itself in any other part of its entire length.

The electrical machinery for modern rail welding is almost perfect in its equipment and operation, but the operator must be a skilled workman who in the last analysis must determine the success of the job. The track welder is mounted on a small trolley car of special type which carries with it a complete outfit of all things necessary for work. With this trolley car made to adjust itself to a track of any gauge, the work can proceed anywhere with equal facility. Either the welding of new rails or the repairing of old joints can be effected with promptness by one of these trolley car equipments.

The first step in the process is to remove all dust, grit, grease and rust from the joints by means of the sand blast. The trolley car carries a strong sand blast, which is operated by the motor. The blast is driven by an air compressor, which receives its power from a storage tank mounted on the car. The electric motor operates the compressor, and fills the storage tank. There is a good size sand bin and a mixer operated by electric power, and when in use the blast of air carries the fine sand against the surface of the rail joints under continuous pressure. The cleansing of the joints by the sand blast, whether they are new ones or old ones being repaired, must be carefully attended to, for in the early welding processes less attention was given to this part of the work, and the joints were always breaking. A hose and nozzle carry the blast of sand to the rails and quickly remove all foreign substances.

When the rails are cleaned they are brought up to a perfect level by measurement, so that the joint will prove continuous and perfect. The rails beforehand are supposed to be made perfectly level on the graded street. The welding machinery is carried forward of the car on a crane which enables the jaws to move far enough out to grip the rails firmly. The crane is wide enough to suspend double jaws so that the welding can proceed on the two rails at the same time. The operation of the crane, which controls the jaws of the welder, is worked from inside of the car by means of a shaft and friction clutches. The shaft of this crane is run continuously during the process of welding by a five-horse-power motor.

During the process of welding the transformer and faces of the rails must be kept cool, and a circulation of water kept up over them by means of a small rotary pump which is operated by the same motor. Ingenious devices have been made to cool this water as rapidly as possible after it has come in contact with the hot rails. It passes from the hot rails to an outer portion of the tank, which winds around to a false bottom through which air is forced by powerful blowers. This forced air tends to cool the water rapidly as it passes around the tank, and by the time it reaches the tank again it is almost as cool as in the first place. It can then be used over again, and passes through the old process of heating and cooling.

When the rails to be joined are gripped into the jaws of the transformer, the flat-rolled steel bars are put in position. These bars of steel have at either end slight projections which are to connect with the web of the rail. When the bars are in position across the joint, the jaws of the welder are swung into position and made to grip them firmly. This process is quickly done, for the bars of steel are fitted beforehand, and a workman can soon place them where needed. The current is then turned on, and it flows through the bars to the rail web.

The welding is done by an alternating-current transformer, with primary windings of two coils in parallel, of forty turns each. The jaws are held in position on either side by large levers, and a hydraulic jack connects these levers together about two-thirds of the way up. The necessary pressure is obtained in this way to draw the rails together and force the bars of steel firmly against the rails. This pressure can be regulated from a few tons to thirty-five tons and more.

It has been found that the welding of

the joints is increased by alternating the pressure, and it is a prime necessity that this change in the power of the jaws shall be regulated easily. The pressure is alternated frequently by the operator until finally it is brought up to the welding point when the union is made complete. At this critical moment the current is cut off and the full welding pressure put on the rails. The pressure is held until the heat of the rails has been greatly reduced. This final pressure at the welding point requires careful manipulation, for if the operator does not understand the relative importance of great pressure and great heat applied at the critical moment the joint will not prove a good one. The strength of the weld has been found to be increased very materially hy holding the pressure for an indefinite time. The ends of the joint require this heavy pressure after the weld more than the centre sides, and the jaws are made to bring the weight on the ends. When the bars of steel are in an expanded condition the ends should be welded, and consequently the improved method makes the centre weld first, and then without stopping to let it cool under pressure the ends are quickly welded. As a result of this method the greatest elongation of the bars is obtained, and as they cool off and shrink the joints are pulled closely together. The result is a tight and strong joint. Good workmen can, in fact, make a joint that shows no opening at all, and the rail appears, to all practical purposes, one continuous, unbroken length.

When the rails are thus joined in a tight weld they are as strong as the ordinary rail, and it requires a good deal of a strain to weaken the joints. The grinding off of the heads to make the surface perfectly smooth and continuous completes the process. A good many joints require very little grinding to complete the job when new welds are being put together for the first time, but in repair work this is quite otherwise. Then the two rails are not always equal in height and breadth. In welding old rails one is very apt to be higher than the other at the joint, and grinding is necessary to bring them down to the exact level. Inequalities in the surfaces of the rails at the joints make hard riding, and cause more trouble to the cars and springs than anything else. The grinder is generally made of an emery wheel mounted on a carriage and separate from the trolley car. It receives its power from the motor on the trolley, however, by means of a swing frame.

It requires from two to three minutes to complete a weld, or rather the current is turned on for that length of time to complete the most important stage of the process. In this time a voltage of about 500 and 225 amperes is consumed. The total current used in the operating plant is from 20,000 to 30,000 amperes, but the regulating apparatus maintains a constant voltage of about 300 regardless of everything else.

The advance in street rail welding has been so marked that it has become necessary to all well regulated roads. Modern passenger traffic demands rails with their joints welded so that there will be no jolting in crossing from one to another. Moreover, operating expenses have indicated that there is economy in welding rails in the end. The saving on the cars and rolling stock is so great when used on perfectly smooth, uniform rail surfaces that few companies would to-day consent to return to the old system of loosely joined rails, with here and there wide spaces between, and with the ever-present danger of accidents by pieces of the rails slivering off. Under the present system such accidents are mechanical impossibilities. The weld is so complete and firm that there is no possible chance of a splinter being started at any of the joints.

K. Mey has made some observations of the cathode and anode falls of potential near the surface of electrodes consisting of potassium or sodium. When the gas is nitrogen, the nitrides NH_3 and NNa_3 are produced and when it is hydrogen there is a probable formation of KH and NaH. The absorption of nitrogen takes place chiefly at the cathode. The formation of the compounds mentioned provides an excellent means of separating the rarer gases, such as helium and argon, from the commoner ones. It is best to employ a cathode made of sodium-potassium alloy for the purpose. In helium, the anode drop of such an alloy is high, and thus confirms Skinner's supposition, that metals of low cathode drop have a high anode drop. In helium also, the alkali metals show the smallest known cathode drops, being thirty volts for sodium, sixty-nine for potassium and 78.5 for the alloy. This may have some connection with the photoelectric power of the same metals. The series of metals arranged according to their cathode fall is the same in every gas, and is identical with the Volta series, or the series of densities, or the series of affinities for oxygen.

Sterilization of Water by Ozone.

In *La Review Technique,* Dr. E. Imbeaux describes several methods of applying ozone to the sterilization of water. A short account is given of the discovery of this substance and experiments upon its oxidizing and sterilizing properties. Early tests were made by Siemens, Froehlich and Tyndall. The latter exhibited his apparatus at Brussels in 1997, when the Belgian Government experimented with it. Marmier and Abraham have been developing an apparatus for making ozone since 1895. The present form consists of a closed chamber containing two cast-iron plates. These are placed parallel, and the opposing faces are covered by two glass plates. Air enters the chamber from one end and passes between the two glass plates and out through a pipe carried through the centre of one plate. The two iron plates are connected to the secondary of a transformer supplying 40,000 volts. In parallel with the plates, but not within the chamber, is a spark-gap which limits the applied voltage so as to prevent arcing between the plates. This gap also sets up oscillations in the circuit, which are said to be beneficial in producing ozone. The brush discharges take place around the glass plates, and thus act upon the air in its passage through the chamber. Another apparatus has been developed by Otto in France. He has found that the brush discharge is most effective when in producing ozone the potential approaches the sparking point, and his apparatus is designed to use high potentials, but to prevent continuous arcing, which would form nitric acid. The apparatus consists of an iron chamber, in which is a shaft fitted with iron discs. A portion of the rim of each of the discs is cut out, the breaks being arranged in a spiral when the discs are on the shaft. The wall of the chamber is cut away parallel to the shaft at one point to form a duct. When in operation one end of the high-potential circuit is connected to the shaft which revolves and the other to the chamber. The brush discharge takes place between them. If an arc jumps from any disc to the case it is broken as soon as the break in the disc comes opposite the duct in the chamber. Air is drawn in at one end of the chamber and passes out at the other. The Siemens & Halske apparatus consists of a closed chamber containing cylindrical concentric electrodes. This apparatus has already been described in the ELECTRICAL REVIEW of December 27, 1902. In all of these systems the water to be treated is passed down through a vertical tower, and in its passage is brought into contact with the ozonized air.

A Three-Phase Power Transmission Plant Using High-Tension Motors.

By Frank C. Perkins.

THE use of high-tension alternating-current motors directly from the power transmission circuits is not a common practice, but a number of important plants have been installed which employ motors of large size in this way, the power being used in manufacturing plants and also in substations where the current is converted from alternating to continuous for use with storage battery, three-wire distribution.

One of the most interesting plants of this character is that in Allgeau, the current being generated at central power stations at d'Au and Thalerschachen, and supplying light and power to a number of villages between Wangen and Leutkirch, a distance of nearly fifty kilometres. The high-tension synchronous motors are used in various factories, and also in the substations, driving generators of the direct-current type, as motor-generator sets for charging storage battery plants which supply current for both light and small motors in the neighborhood of the substation. This transmission system was installed by the Machinenfabrik Oerlikon, of Oerlikon, near Zurich, Switzerland.

The necessary water power is obtained from the river Argen, the plant at d'Au being fifteen kilometres from Wangen and two and one-half kilometres from the power station at Thalerschachen, which is also supplied from the river Argen through an aqueduct and canal, with water under a head of seven metres, the penstocks having a capacity of 3,000 litres per second.

The interior of the generator and switchboard room at the Thalerschachen power-house is seen in Fig. 1, illustrating the method of power transmission from the turbines to the generators.

The power station at d'Au is supplied with water from the same source, under a head of 9.9 metres, the capacity being 3,400 litres per second.

The interior of the generator room of the d'Au power-house may be seen in Fig. 2.

The Thalerschachen central station has a floor space of eighty square metres and is supplied with a Jouval turbine constructed by the firm of Escher, Wyss & Company. This turbine has a capacity of 210 effective horse-power, 3,000 litres of water per second being used under an available head of seven metres. The turbine operates the high-pressure generators by means of belt transmission.

The Oerlikon three-phase generators installed in this power-house have each a capacity of 100 horse-power and are operated at a speed of 500 revolutions per minute. The three-phase current generated has a frequency of fifty periods per second, and has a potential of 5,000 volts. The armature of this machine consists of eighteen coils, twelve of which have 114½ turns, and the remaining coils 115 turns of copper wire, one and one-third millimetres in cross-section. These windings are arranged on the coils in five layers.

FIG. 1.—INTERIOR OF POWER-HOUSE AT THALERSCHACHEN.

It will be noticed that the exciting generators are bipolar machines, directly connected to the shafts of the alternators.

The switchboard noted in the accompanying figure in this power station is supplied with the usual voltmeters, ammeters, synchronizing lamps and transformers. In addition to the transformers for the measuring instruments a one-kilowatt converter is used for supplying lights to the power stations. The switchboard is exactly similar to that in the second power plant at d'Au.

The turbines in the d'Au station consist of two wheels of the Francis type constructed by the firm of J. M. Voith, of Heidenheim. The turbines are installed five metres above the tail-race so that one-half of the head is utilized by the draft tube. The turbines are regulated either by hand or automatic regulators. These turbines each has a capacity of 168 horse-power under a speed of 175 revolutions per minute. The flow of water is 1.7 cubic metres under an effective head of 9.9 metres.

The generators of this plant are also operated from the turbine by a belt transmission. The pulleys have a diameter of 800 millimetres and a width of 500 millimetres. These Oerlikon dynamos are of the three-phase type, supplying an alternating current of 5,000 volts, the frequency being fifty periods per second and the speed 500 revolutions per minute.

The revolving core has a diameter of 1,050 millimetres, the armature's internal diameter being 1,055 millimetres. The armature winding consists of two sets of eighteen coils, each having fifty-four turns of copper wire 2.4/2.9 millimetres in section. These windings are arranged in five layers. The field coil consists of 483 turns of copper wire 5.0/5.6 millimetres in section arranged in twenty-three layers of twenty-one turns each. The dynamos for exciting the field of these alternators are directly coupled to the generator shafts, as seen in the illustration, bipolar machines being used of somewhat different construction from those at the Thalerschachen power plant.

The high-tension power transmission lines from the central power station at d'Au consist of fifteen conductors each

having a diameter of 3.5 millimetres and a total length of 48.3 kilometres. The total length of conductors used is 290 kilometres with a weight of 24,685 kilogrammes. The total number of poles used is 1,000, those between the power stations and Wangen being from fifty to sixty metres apart and those between d'Au and Isny and Leutkirch from forty to forty-five metres apart. The poles are twelve metres long and set 1.8 metres in the ground, the latter portion being impregnated with mercury sublimate. There are two transmission lines of six conductors from the power station at d'Au and Thalerschachen to Wangen, one of which operates a 100-horse-power high-tension 5,000-volt synchronous motor in the Cellulosefabrik and a forty-two-horse-power high-tension motor in the Papierfabrik at Wangen; and the other line supplies current to the high-tension motor of the motor-generator set in the transformer substation at Wangen, seen in the accompanying illustration, Fig. 3. A second transmission line of three conductors supplies current to the substation at Isny, and a third line is installed to the substation at Leutkirch. In the substation at Wangen, which is six metres long, 9.5 metres wide and three metres high, there are several rooms, including repair shop, switchboard, storage battery plant and motor-generator rooms.

It will be noted that the motor-generator room, seen in Fig. 3, is quite artistically decorated. The machine consists of a sixty-horse-power high-tension synchronous motor of the Oerlikon type directly coupled to two thirty-horse-power direct-current machines, all three machines being carefully insulated from each other by flexible insulated couplings and also from the foundation by porcelain supports.

The synchronous motor operates at 1,000 revolutions per minute, the frequency being fifty cycles per second and the potential 5,000 volts. The motor armature has nine coils embedded in eighteen slots or grooves. Each of these coils consists of 131 turns of copper conductor 1.6 by 2.2 millimetres in cross-section.

Both of the armature windings are connected in series. The exciting coil has 1,700 turns of copper conductor measuring 2.2 by 2.6 millimetres.

Both of the direct-current machines are of the shunt-wound type, supplying a current of 125 volts at the normal speed of 100 revolutions per minute. The armature core is 316 millimetres in diameter and 250 millimetres wide, and has eighty-one slots or grooves measuring 6 by 21 millimetres. Each groove has two conductors of two wires each in parallel 4 by 4.6 millimetres in cross-section. The commutator is insulated with mica of six millimetres thickness between each of the eighty-one commutator bars. The field magnet cores are 324 millimetres in diameter, and each of the four coils consists of 850 turns of copper conductor 2 by 2.4 millimetres. The switchboard noted in the background controls the motor-generator set as well as the storage battery plant which is located in the adjoining room. The battery installation consists of two sets of sixty-four cells each. The capacity of this accumulator outfit is 540 ampere-hours at a discharge rate of 180 amperes, supplying current to the lighting distribution circuits which are operated on the three-wire system.

The substation at Isny is 7.8 metres long, 6.6 metres wide and 3.3 metres

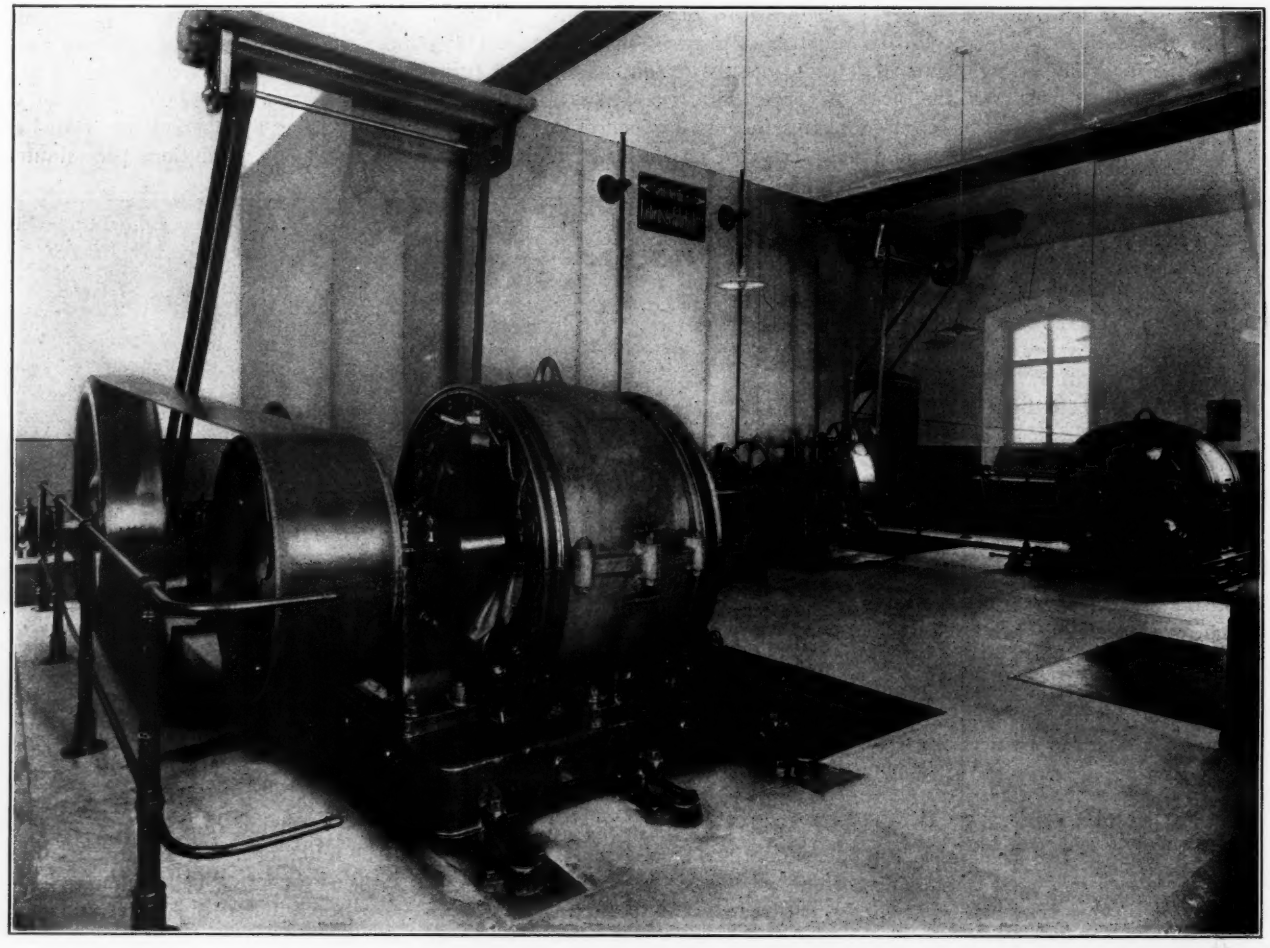


FIG. 2.—INTERIOR OF POWER-HOUSE AT D'AU.

high, and is similarly equipped to that at Wangen just described. The storage battery plant at Isny consists of seventy cells of a capacity of 750 ampere-hours, the maximum discharge rate being 252 amperes.

The substation plant at Leutkirch is 8.7 metres long, 6.75 metres wide and 3.55 metres high, and is equipped with a motor-generator set similar to that at Wangen, and has the same number of cells and capacity of storage battery plant.

The construction of the high-tension motors used at the paper factory and the cellulose factory at Wangen may be of interest. The former has a capacity of forty-two horse-power and the latter 100 horse-power, and they receive their current from the three-phase 5,000-volt line from the power station at d'Au, about fifteen kilometres away. They are synchronous motors of the Oerlikon type, the forty-two-horse-power machine having a speed of 750 revolutions per minute. The armature winding of this motor consists of twelve coils of copper conductor; each of a cross-section 1.4/2 millimetres, 130 turns being used on each coil. The excitation coil has 780 turns of copper conductor 3.3 by 3.8 millimetres in section.

For lighting the various villages at a distance from the substation step-down transformers of the three-phase type are employed, ranging from two kilowatts to ten kilowatts in capacity. The lighting circuits near the substations are operated on the three-wire system from the storage battery plants. The private lighting includes several thousand lamps of five, ten and sixteen candle-power each, while the public lighting utilizes incandescent lamps of twenty-five candle-power and numerous arc lamps at Wangen, Isny and Leutkirch.

On the low-tension circuits there are fifty-two motors in operation ranging in size from one-eighth horse-power to fifty horse-power, and the cost for power varies from 300 marks per year for motors of one-eighth to three-fourths horse-power to 200 marks and 150 marks per horse-power per year for motors of one to ten horse-power and ten to fifty horse-power, respectively.

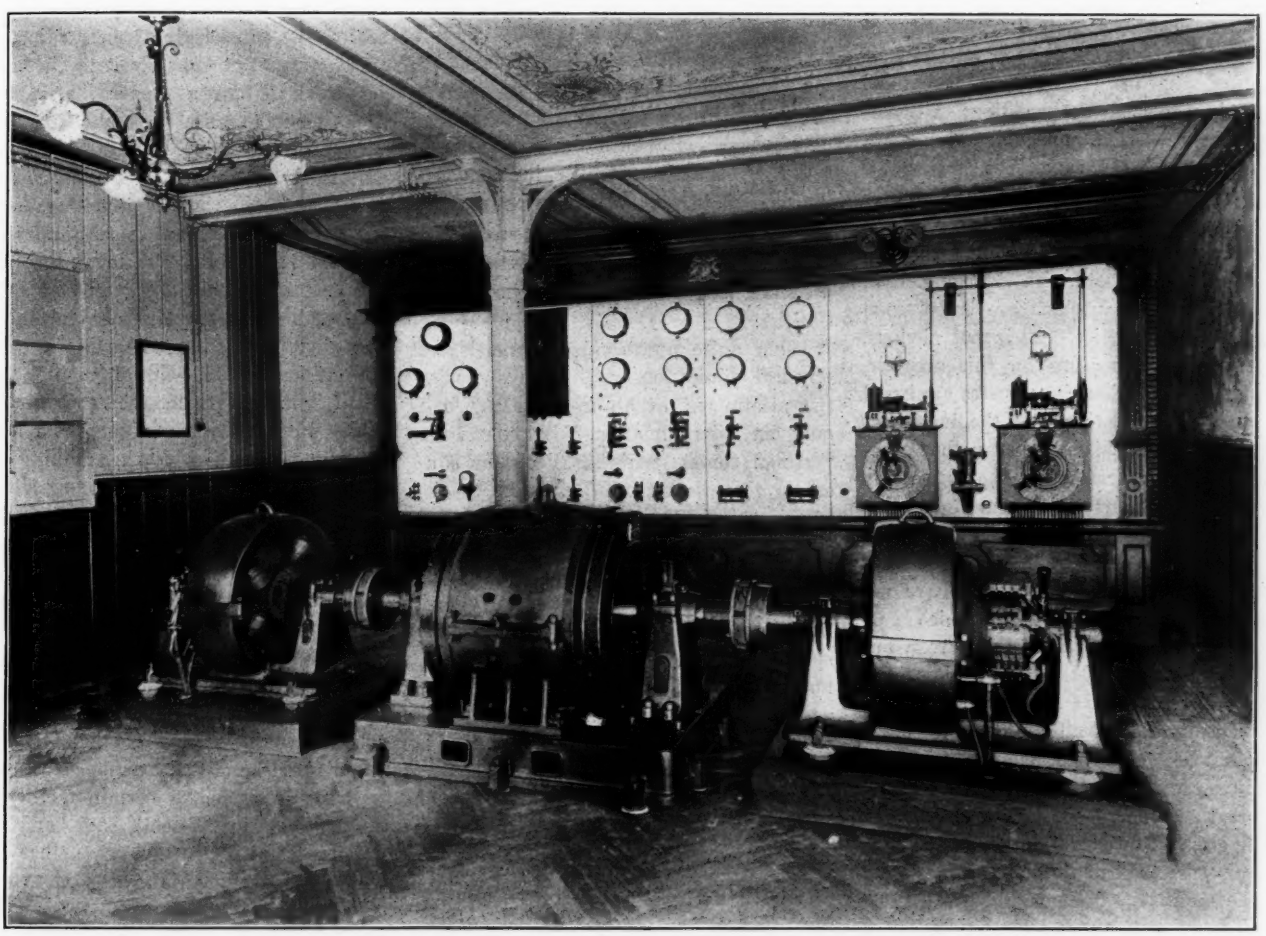


FIG. 3.—TRANSFORMER SUBSTATION AT WANGEN.

Shipments of Rubber from Para.

Under date of June 6, 1903, Consul K. K. Kennedy says: "The shipments of rubber from the Amazon Valley during the month of May just passed amounted to 2,070 tons, as against 2,083 tons for the same month in 1902. The total export of rubber for this season—July 1, 1902, to May 31, 1903—is 28,110 tons, as against 28,738 tons for the corresponding period of the previous season. It does not appear likely that the business of this closing month of the season will materially change the relative bearing of these figures. The crop shortage this year, as compared with the year of 1901-2, will therefore be only about two per cent, instead of five per cent as estimated January 1."

Whenever electricity is used in connection with cyaniding there is a larger expenditure of chemicals, and the base metals are dissolved to a much greater extent along with the gold and silver. However, when electric current is employed, a weaker cyanide solution may be employed, as its action is increased by the current.

PROPER QUALIFICATIONS OF ELECTRICAL ENGINEERING SCHOOL GRADUATES FROM THE MANUFACTURER'S STANDPOINT.[1]

BY L. A. OSBORNE.

Any discussion having for its subject the educational needs of a student of engineering must necessarily be limited to the particular requirements to be met. It is therefore proper to state in the beginning that the writer has in mind the requirements of a particular industry and his views are therefore controlled by the environment with which he is most familiar.

It is probable that the majority of young men who enter upon a course of engineering in one of our technical schools rarely have expectations of devoting their energies to engineering pure and simple. My experience has shown that the average young engineer rather expects that his preliminary training and education will be of assistance to him in obtaining a foothold with the commercial side of industries which are based upon engineering practice. It is not obvious, in seeking for reasons for this attitude, whether our engineering courses are based upon the assumption that the industrial world requires business men with a technical training or whether the supposedly larger emoluments which come to men of affairs rather than to specialists and designers has its effect in diverting the energies of young men after they have departed from the influences which surround them in their academic career, but I believe that the latter is the determining factor. However that may be, my experience is that of all the technical graduates who obtain employment with the industry with which I am connected, not more than one in ten is fitted either by temperament or education to take up with success the work of pure engineering.

Temperament undoubtedly has a great deal to do with it, and the tendencies of modern industries to demand technical training of men in its commercial departments undoubtedly have the effect of inviting men to take the technical courses, where if there was not that incentive they would have devoted themselves to some other line of activity. There is therefore graduated every year a large body of men who are added to the engineering profession but who are not properly fitted to deal with engineering questions broadly.

On the other hand, the courses which these men have followed have generally not pretended or considered any other probability but that they are to become engineers pure and simple. There have consequently been turned out a body of men who are by inclination not prepared to follow the so-called drudgery of the profession. At the same time they have been given little instruction or special preparation for the lines of work into which they will obviously drift.

I can not but believe that the majority of men before they have completed a four years' course in college have given some indication to the faculty of their ultimate tendencies. It seems, therefore, as if it were desirable either to differentiate between these two classes of men, with the result that each would be better prepared for the work which they will ultimately be called upon to do in the world's activities, or better still to broaden out the courses in certain particulars to the end that the whole body of engineers will enter upon their work with a fuller comprehension of its duties and its opportunities.

I am quite aware that financial and physical limitations will always render the attainment of an ideal at the best only an approximation. I know from personal contact with many of our educators that they are fully awake to the growing demands of the profession, and that generally the most earnest efforts are being made to meet these ever-increasing requirements. My remarks should therefore be taken in the spirit in which they are given, that is, not in criticism of existing methods, but as an endeavor to point out conditions which might be considered as desirable to work toward.

In considering whether the training of the modern engineer is adapted to the demands which will be made upon him later on, we should bear in mind certain latter-day tendencies which have largely come about through engineering practice.

There was a time in the history of manufacturing when its activities were directed largely by men who had grown up from apprentices in the shops and who were primarily machinists and workmen. The work of modern engineering has resulted in the development of enormous industries which require skill, intelligence and knowledge and a high order of administrative ability, which was entirely unnecessary in the days of small shops and limited organizations. It has followed that the problems incident to this great industrial development have been more than the limited education and intelligence of the old-time shop superintendent could cope with.

The inventions and discoveries which have revised modern industrial practice have been made by comparatively few men. The activities which have been consequent upon these inventions and discoveries require an army of trained men to supervise and direct them. It is in this field that the average engineer can hope to find an outlet for his best talents. I am not now speaking of the few men who by temperament and by making the best use of the opportunities offered in the technical schools will ultimately develop into world-recognized engineers, but of that great body of men trained in engineering, who must look to the more general fields for a proper environment in which to exercise their abilities.

In this short paper it is not my intention to do more than to point out suggestive thoughts, hoping that the discussion, which is always more important than the paper itself, will bring forth the opinions of our members on this question, and will do much to aid us in defining our views upon the subject.

Considering the field of manufacturing it is my experience that not one in a hundred engineering graduates ever looks to that as holding forth anything attractive as a scene of his future labors. Manufacturing to-day in any industry is a proper field for an engineer. It is unnecessary for me to set forth the countless opportunities which any manufacturing concern, be it great or small, offers for the exercise of engineering judgment.

It is true that our technical schools devote a certain portion of their time to "shop work," and endeavor to give to the engineering student a certain facility in the manipulation of tools, both hand and machine; but it is very rare that the school makes any serious attempt to take up those larger questions of the adaptation of tools to special purposes or give instruction in general in the principles which underlie the tool organization of a shop. Consequently the student's interest is not stimulated and the majority of the technical school graduates leave college with but very hazy notions either of the function of tools, the principles of their design or the machine organization of a shop. In connection with manufacturing it is also certain that a more thorough knowledge of works organization as applied to the personnel would not only stimulate the interest of the student in this most attractive field, but would be of the greatest importance to

[1] A paper presented at the twentieth annual convention of the American Institute of Electrical Engineers, Niagara Falls, N. Y., July 3, 1903.

his future employers, the industrial concerns throughout the land.

Almost without exception an engineering graduate enters a machine shop in utter ignorance of the principles which should underlie its organization and personnel. It is true that familiarity in these lines comes largely from experience, but it is also true that there are large fundamental facts underlying all successful examples of shop practice and shop organization, which should be of the utmost value to an engineering student.

Another very important function of the man whose work is the supervision of manufacturing processes is the subject of works accounting. Works accounting based upon general accounting practice is a closed book to the average student of engineering. I have been unable to find in the curriculum of any technical school that I have examined any course of study which remotely suggests that this would be desirable knowledge for an engineer. The matter of shop accounting is not a matter for the ordinary expert accountant to deal with. The man who knows the cost of his product—and upon this knowledge success absolutely depends—must adapt the fundamental laws of accounting to the particular cases with which he has to deal. There is no more important knowledge required of a works manager than an adequate knowledge of proper accounting methods. In criticism of this it might be said that ordinary accounting and bookkeeping is a thing which any intelligent man might readily acquire, but my opinion is that it would be much better for our engineering courses to recognize the important relation which this branch of knowledge has to modern engineering work and the advantage of including it in the curriculum would lie in bringing the importance of the subject prominently to the student's attention.

All engineers if they expect, as all do, to achieve prominence in their profession, must sooner or later come in contact with labor. There is no more vital subject facing the industrial world today than the relations between employers and labor. Every engineer may hope sooner or later to be an employer of labor. To enable the engineering student to understand the economic laws which govern the relations between employers and labor would add enormously to his value in a general way. The engineering student to-day has no insight into these questions except as he may gather his opinions through the newspapers or through such desultory reading as he may choose to do; the result is that the engineering student is not brought to an appreciation of the enormous influence which this question must have on our future industrial progress. A course which would bring to the student's attention the history of the relations between capital and labor and the economic laws relating thereto would be suggestive and call to his attention vividly its importance, and arouse in him a realization that this is a question which he some day might be called upon to treat intelligently.

On the commercial side, all engineers sooner or later must come in contact with the problems which introduce questions of business practice. The consulting engineer, the engineering salesman, and the designing engineer will, sooner or later, be called upon to enter, either directly or for his employers and clients, into contract relations. As it stands to-day the engineering student leaves college with the haziest notions of the principles underlying the law of contracts. Under the circumstances it would seem well if our engineering courses included a short course of law in its relation to contracts.

It may be said that all these things have nothing to do with engineering. This is partly true, but my plea is for engineers of broader horizons. Our technical schools to-day are admirably fitted to turn out men who are well grounded in the fundamentals of engineering. As a rule they are good mathematicians, electricians, chemists and physicists, and have all the technical knowledge necessary for pursuing the profession, but they are as a class woefully lacking in that they have no comprehension whatever of many of the subjects which are inseparably connected with the practice of the profession.

I believe that much of the manual training, which now occupies such a large proportion of the "actual hours' work" in the courses of most technical schools, could be replaced with profit by lectures on subjects related to those which have been mentioned in this paper.

No attempt has been made within this short paper to more than touch what has appealed to the writer as being the more important and most noticeable qualities lacking in the mental equipment of the average technical graduate with whom he comes in contact.

Peru Electrical Enterprises.

Of late years there has been a notable extension of electric force and electric lighting in Peru. Lima is now lighted throughout by electricity, and in many establishments the machinery is driven by electrical power. A number of the cities in the interior also enjoy the benefits of electric lighting.

Two syndicates have recently been formed in Lima for the construction of overhead trolley tramways. One is La Compañia Anónima Tranvia Eléctrico de Lima y Chorrillos. This company proposes to build an electric tramway from Lima to Chorrillos, passing through the small boroughs of Miraflores and Barranco, lying between Lima and Chorrillos. The distance is about fourteen kilometres (8.6 miles). The line will be double tracked and the cars will run at intervals of about ten minutes. The capital is £80,000 ($389,320), divided into shares of £1 ($4.86) each.

The other company is called Ferrocarril Eléctrico de Lima y Callao. This line is also to be double tracked and will connect Lima and Callao, a distance of about 13.7 kilometres (8.5 miles). This company also intends to construct tramways in the city of Callao. Its capital is £100,000 ($486,650), and it intends to compete with the existing railways for the carrying of freight as well as passengers between Callao and Lima. The passenger trains are intended to be run, like those of the other company, every ten minutes.

The government gives to these two syndicates a privilege for sixty-six years. The two companies are to be free of taxes, and are to import free of duty for the term of two years all material for their own use. At the end of sixty-six years, the tramways, rolling stock, and all material become the property of the government free of cost.

Both the electric tramway companies have made arrangements with American manufacturers for the supply of the plant and material to equip the lines, and it should soon begin to arrive, as the lines must be finished and in working order within two years from the date of contract with the government.

These facts were obtained from the interesting report to our government by the Hon. Joseph C. Cree, vice-consul at Callao, May 8, 1903.

Technology Quarterly.

The June issue of the *Technology Quarterly,* published by the Massachusetts Institute of Technology, contains the following articles: "The Figure of the Earth from Pendulum Observations," by Mr. G. L. Hosmer; "A Study of the Geology of the Charles River Estuary and Boston Harbor," by W. O. Crosby; the first section of a serial article upon "A System of Quantitative Analysis, Including Nearly All Metallic Elements," by A. A. Noyes; and "The Composition of Sewage in Relation to the Problem of Disposal," by Mr. George W. Fuller.

WHY ENGINEERS SHOULD ADVERTISE.[1]

BY GEORGE H. GIBSON.

We hear much nowadays about the dignity, the honor and the glory of the engineering profession. At the same time the correspondence columns of the technical journals are filled with complaints concerning the meagre compensation usually received by engineers. These things do not harmonize. If the engineers, by virtue of their skill, ability and integrity, are indispensable in this industrial age, why are they not better paid? There are but two classes of people who can be held responsible for this state of affairs, *viz.*, the engineers themselves and their employers, the public. Some of the blame rests upon each, but most of it upon the engineers.

In the first place, most people, including many otherwise well informed, have a very hazy notion of what an engineer is and what he does. They perhaps think of him as somewhere between a highly skilled mechanic, or artisan, and a professional man consulted as an expert in cases of dire necessity. They rarely regard him as a man of affairs, capable of directing and conducting large enterprises. That this is the case is shown very clearly by the attitude of state and municipal governments toward engineers and their salaries. For instance, the wealthy state of New York advertises for engineering assistants in the office of the state engineer, offering the munificent salary of $5.00 per day for days actually worked, nothing for overtime. Bricklayers in many cities are paid $5.20 for eight hours labor and double pay for overtime. The "buyers" of department stores often receive more than $2,000 per year. Again, Kansas City, Mo., is making important and costly additions to its water supply system. In connection with this work three consulting engineers have been retained. In spite of the fact that the advice of these men may result in the loss or the saving to the city of thousands of dollars, the Kansas City *Journal* complains that one "has been added to the city pay-roll at a salary of $1,500 a year and annointed with title of "consulting engineer," and that the services of the others "cost the city $15 every time they blink an eye," that is, they are paid $15 per day when their services are required. No large city would think of employing legal talent at wages so small, and at the same time nearly every municipality is engaged in engineering undertakings upon which the profit or loss due to good or poor engineering judgment and skill may amount up into the thousands or even millions of dollars. Due to poor engineering, or the absence of any at all, hundreds of lives annually are lost from typhoid fever in some of our large cities, a loss which could be almost entirely prevented by the application of well-known engineering methods.

Now it is plain that the only way in which public opinion in regard to these matters can be reformed is by education, and it is equally plain upon whom rests the responsibility of doing the educating. The engineers must speak for themselves. They must educate the public in engineering matters. It is as much to the interest of engineers as of lawyers or bankers to take an interest and part in public affairs and to educate and direct public opinion. The engineer should advertise the engineering profession for the good of both the profession and the public. A beginning has been made in this by engineers like Kent, Thurston and others, who have sought to bring to public attention the great revolution in the industrial and social world being brought about by the activities of the engineer. Much is also to be expected from the efforts of those, notably Mr. C. F. Scott, now president of the American Institute of Electrical Engineers, who are endeavoring to draw the national engineering societies together into a united, harmonious and powerful body. Since the above was written, Mr. Carnegie's generous offer of $1,000,000 to erect a building in New York city for the national engineering societies has placed this movement upon a substantial footing.

The timeliness and importance of such movements are manifest when we consider that fifty years hence the engineer will probably hold a position of vast power and influence in the social organism. His work touches organization, financiering, management and, ultimately, statesmanship. He is forced to study political economy thoroughly and at first hand. He is destined to become and is becoming the leader of vast industrial organizations and, perhaps eventually, of the world itself. In the beginning the world was superstitious and ignorant and its rulers were priests; these were followed by soldiers who have disciplined it, and these again by lawyers, who have established the principles of civil rights. The great questions of the present and future are industrial and commercial. Science and invention should naturally, it would seem, place the source of wealth and power in the hands of the engineers, who should next hold the reins. This is not to be understood in any absolute or revolutionary sense, but it is to be noted that the professionally trained engineer is more and more becoming a man of affairs. His active life, exacting duties, accurate habits of thought, earnestness and integrity fit him to be the leader and adviser of men.

However, our exultation in the bright prospects of the engineering profession has perhaps caused us meanwhile to forget the individual engineer. As above pointed out, his pay is not always commensurate with his prospects and he can not live comfortably upon prospects in general and nothing in particular. His practice of "the art of directing the great sources of power in nature for the use and convenience of man" is not always supplemented by the art of being well paid for that practice. It would seem that there should be no great difficulty in selling at a good price services so profitable to the purchaser as those of the engineer, but it appears that he usually fails to do it.

Careful consideration of the subject seems to indicate that the limited financial success of many technical men arises more from lack of business perspective and enterprise than from anything else. First, they do not advertise enough. It is one of the first duties of every man to let the world know what he is good for. Honest advertising pays both parties concerned. If you can do a thing better than it is generally done, you should tell about it. It may help some one else, but it will probably help you most, besides, you don't need to give the whole secret away. In other words, engineers should write articles for the technical press based upon their work, study or observation. Such articles are valuable to refer to when applying for positions or soliciting work. They form the cheapest form of personal advertising, since they are usually productive of revenue. Most technical papers will gladly publish and pay for articles of any merit. Men are known for their ideas, and an idea properly disseminated has more advertising value than a vast amount of money. A man of real enterprise, however, will not stop with technical press, but at opportune time will discuss in the public press engineering and economic subjects of popular interest, such as the purification of public water supplies, public transportation, the fuel situation, gas and electric lighting, and many others of equal importance.

[1] Reprinted from "The Michigan Technic," 1903.

Proceedings of the National Electrical Contractors' Convention, Detroit, Mich., July 14, 15, 16 and 17.

FIVE hundred names were registered at the third meeting of the National Electrical Contractors' Association, held in Detroit, July 14, 15, 16 and 17, and it is estimated that from 100 to 200 others interested in the progress of electrical matters were visitors at the meeting.

This session proved a surprise to many as it indicated clearly the strength and importance and the excellent character of the men identified with this branch of electrical work in the United States. For several years the electrical contractors in all parts of the country have been greatly harassed by the condition of the labor market, resulting in strike complications and in many cases long suspension of construction work. This and other questions of interest to contractors throughout the various parts of the country brought about a meeting of a number of electrical contractors four years ago, which resulted in the formation of the present organization.

Up to the present time all the sessions of this association have been held behind closed doors, and members only were allowed admittance. It has been, too, the attitude of the association to withhold information as to its proceedings from the press, not necessarily because the matter of the proceedings could not be printed with perfect propriety, but the points discussed were mainly of a non-technical nature pertaining to the adjustment of methods of buying from manufacturers, the attitude toward non-union labor, and subjects not of general interest to the public.

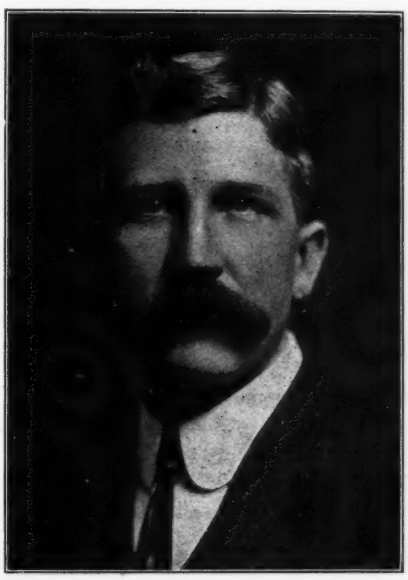
Much of the discussion and the proceedings in the several meetings had a direct bearing on the matter of dealing with manufacturers, of equipments used in construction work, such as conduit, lamps, sockets, porcelain products, wires, etc. This part of the proceedings is of especial interest to manufacturers.

As the result of the present session much has been done toward clearing the atmosphere, and it is believed that the strike difficulty will be minimized immediately and that in future this trouble will not continue as a serious embarrassment.

The first executive session was held at ten o'clock, Tuesday, July 14, with the president, Mr. Charles L. Eidlitz, in the chair. This was an open session and the delegates listened to an address of welcome by Mayor William C. Maybury, of Detroit. In a felicitous address the Mayor extended the freedom of the city to the visiting electric men, and in conclusion remarked that Detroit has the honor of being the home of Thomas A. Edison, during a portion of his boyhood. After this open session, business meetings were held daily.

Many of the contractors present left Detroit with the satisfaction that the gathering had been productive of great good and that the organization would hereafter be a strong factor in the electrical industry.

One of the prominent members remarked to a representative of the ELECTRICAL REVIEW, "The national labor board which has been appointed surely will work great good. The purposes of this board are the consideration of the difficulties with which we have been confronted and the attitude will be to deal with the question in a fair, broad and kindly spirit."



ERNEST MCCLEARY.
President-elect National Contractors' Association.

The purposes of the board also are to secure the names of all employers of labor in electrical construction work throughout the country to confer with them as to their difficulties and advise with them.

The officers elected for the ensuing year are: President, Ernest McCleary; first vice-president, W. I. Gray, Minneapolis, Minn.; second vice-president, Walter C. McIntire, Philadelphia, Pa.; third vice-president, F. P. Coghlin, Worcester, Mass.; treasurer, John R. Galloway, Washington, D. C.; secretary, W. H. Morton, Utica, N. Y.; sergeant-at-arms, J. C. Sterns, Buffalo, N. Y.

The next convention will be held in St. Louis at the World's Fair grounds in 1904, and it is the plan to hold the meeting in 1905 at Denver, Col.

During the present meeting a large number of new members have been added to the membership list, and the association is in excellent condition financially.

The new president, Mr. Ernest McCleary, is a member of the firm of McCleary-Colquitt Company, Limited, of Detroit. Mr. McCleary has served for the last year as director of the association for the state of Michigan, and has been most energetic in the organization. He has a thorough training as an electrical engineer, and also an excellent knowledge of the law, and the latter has been of inestimable value in all sessions of the directors of the association, inasmuch as the legal phase of the questions discussed has been an important element.

W. I. Gray, first vice-president, is from Minneapolis, Minn., he is a member of the firm of W. I. Gray & Company, engineers and contractors, and is especially accurate in electrical matters.

W. H. Morton, secretary, has filled this office for several years and as a tribute to his excellent work his reelection was confirmed. Mr. Morton is a member of the firm of Johnson & Morton, of Utica, N. Y.; he also manages the *National Electrical Contractor,* a publication issued in connection with the association.

On Friday afternoon the gathering was brought to a close by a steamer excursion to the St. Clair flats, where an elaborate banquet was served at the Oakland Hotel. Very many of the delegates and representatives of the manufacturing companies remained after the exhibition had closed to be present at this banquet, which was unusually attractive. Several bright toasts were heard.

A feature of the meeting which created much merriment was the manner in which the eastern delegation arriving on the steamer Western States, Tuesday morning, was received. This delegation had been at the New York State Electrical Contractors' meeting the day before at Buffalo. About 150 electrical men from all parts of the country, headed by Messrs. Gilpin, Bibber and Dale, accompanied by

(Continued on page 122.)

NOTES ON X-LIGHT.

BY WILLIAM ROLLINS.

NOTE CLXIII—PULSATING CURRENTS FOR USE IN THE PRIMARY OF AN INDUCTION COIL.

The advocates of static machines for producing X-light claim that coils are unsuitable because the X-light can not be made steady on account of the break, which they state is a necessary part of an induction coil. I have shown that a break is not a necessary part of an induction coil. The current for the primary may be taken directly from an alternating-current dynamo. When a coil is excited in this way the double-focus tube may be used. Here I wish to correct the common error of ascribing the invention of the double-focus tube to other than Rœntgen. I therefore make the following quotation from his memoir dated March 9, 1896: "A discharge apparatus was prepared especially for experiments with alternating currents of the Tesla transformer; in which both electrodes were aluminum concave mirrors, whose axis were at right angles; at their common centre of curvature there was placed a platinum plate to receive the cathode rays." I especially call attention again to this passage as the double-focus tube has been patented in this country, and attempts made to prevent others than the owners of the patent from making these tubes. I also desire to make another quotation from the same memoir which shows that my statement that Rœntgen was the first to employ the Crookes or single-focus tube was correct, notwithstanding it has been ignored by even the most recent writers, who credit the application to others. This is the passage: "I have for weeks used with great success a discharge apparatus in which the cathode is a concave mirror of aluminum, and the anode a plate of platinum placed at the centre of curvature of the mirror and inclined to the axis of the mirror at an angle of forty-five degrees." Both these quotations are taken from a work by Professor Barker, entitled "Rœntgen Rays," in which the original memoirs are translated into English and are therefore readily verified. It will be observed that in both types of tube Rœntgen made the error of supposing with Crookes that the focus of the cathode stream was at the centre of curvature of the cathode. The fallacy of this was pointed out in notes ii and iii, and experiments mentioned which showed the focus was beyond. The matter is mentioned again because writers continue to state that the cathode stream particles move in straight lines, though my experiments have shown this to be incorrect as a generalization. Though an alternating current can be used in an induction coil without a break, thereby doing away with this source of irregularity in the X-light, it is customary when employing alternating currents in the usual way with a break to use a double-focus tube. I have shown by experiment why a double-focus tube is not desirable for X-light; the target is not an anode and therefore the impact of the cathode stream subatoms is less efficient in producing X-light for reasons already given in detail; and also the life of these tubes is shorter for the gases are more rapidly removed from the terminals. On these and other accounts I call attention to the possibility of operating an induction coil by a direct pulsating current, in which the waves succeed each other fifteen or twenty thousand times a minute, using this current in a properly shaped single-focus tube, and employing, as in the case of the alternating current under the same conditions, a large coil constructed on the plan described in notes cxii and cxxxvii, in which the sections of the secondary are interchangeable.

NOTE CLXIV—ON THE RECOMBINATION OF THE CATHODE STREAM PARTICLES.

In former notes I described experiments which proved that the kind of cathode stream we used to produce a practical amount of X-light was made of subatoms and not of the ultimate particles of either electricity or matter. Not of electricity, for no cathode stream was formed when by heat and heavy surges the gases had been sufficiently removed from the terminals and pumped out of the tube, though the terminals were connected with a powerful source of electricity which on the electron theory should have furnished an abundant cathode stream and much X-light. Not of the ultimate particles of matter, for they gave a familiar spectrum, and ultimate particles must give a new spectrum if we ever get to them. I also showed that these subatoms must recombine, as I could collect the gas formed by the recombination of the cathode stream particles by a special arrangement of the pump, and by introducing it into a spectrum tube could get a spectrum attributed to hydrogen, but since shown by Trowbridge to be that of water vapor. I refer to these old experiments again because they are too interesting in connection with the recent work of Rutherford on radioactive substances to be lost sight of.

NOTE CLXV—ON THE BEARING OF THE VARYING FOCUS OF THE CATHODE STREAM ON THE ELECTRON THEORY.

Those who hold the electron theory of the cathode stream claim it is composed of the natural units of electricity, each of which is like every other. I have already given reasons for not accepting this view of the kind of cathode stream used practically for the production of X-light, but there is another point which may possibly be interesting. In notes ii and iii it was stated that the focus of the cathode stream varied with the electric charge on the subatoms composing it. If the cathode stream was composed of electrons, that is, of particles of electricity free from "matter" and all having the same unvarying properties, the focus of the cathode stream should not vary in such a marked degree, for the greater or less repulsion between the subatoms due to the varying proportion of electric charge to mass (which I stated to be a cause of the variation in the distance of the focus from the cathode) could not exist owing to the sameness of the electrons. In this note I have purposely failed to consider the effect of the residual gases, for the relations claimed by the advocates of the electron theory of the cathode stream appear to make this legitimate.

NOTE CLXVI—ON THE TYRANNY OF OLD IDEAS AS ILLUSTRATED BY THE X-LIGHT TUBES USED IN THERAPEUTICS.

Within two months two valuable textbooks on X-light have been published in America. Each treats extensively of the use of X-light as a remedial agent. This shows the interest taken in this department of what I have called ether-therapeutics. I have examined both of these works, finding every tube illustrated for therapeutic work has a concave cathode. Now Rœntgen first applied the concave cathode of Crookes to an X-light tube for the purpose of reducing the impact area of the cathode stream in order to have the X-light arise from a small surface to ensure sharp definition. When X-light is used in therapeutics sharp definition is not important, therefore for some years I have rarely used an X-light tube with a concave cathode in the cavities of the body—the mouth, for example. When I have used a concave cathode it has been for the opposite reason, namely, to spread, not to contract, the cathode stream. A concave cathode is of no value in most types of tubes for use in body cavities. It is a serious disadvantage when used

in the regular way to bring the cathode stream to a focus, for it is frequently desirable to have the impact of the cathode stream against the glass wall of the X-light tube which is quickly melted by a powerful current when not cooled, or cracked when cooled. It is manifest the risk is diminished when the impact area on the glass is made larger, for the energy of the cathode stream, which is degraded into heat waves, is more widely distributed; the glass, therefore, does not get so hot and may be cooled with less risk.

I have devised many forms of these flat cathode tubes for my work; in all applying the principle first used in 1896, in tubes designed for Dr. Williams—that of cooling the surface struck by the cathode stream. In earlier notes several forms of these cooled tubes were illustrated. The one in which an internal anode was cooled is now a common article of commerce and is attributed to T. D. H. in the catalogues of the tube makers. The second form in which an external anode was cooled is less frequently seen. I first applied it to a modification of Tesla's direct-acting X-light tube, which at that time greatly interested me on account of its symmetry. This method of cooling is of value in therapeutic work with tubes intended to be inserted into body cavities. For these purposes it is well to have the general form of the tube that of a cylinder of such diameter as will easily enter the cavity and to use a modification of a device first applied to X-light tubes by Edison (at least he used it as early as April, 1896), that of external electrodes. Edison found that a tube having internal electrodes if exhausted until no current could pass would become active if the ends were covered with tin-foil. The reason for this has not been given, but it is a very simple one. When the exterior of a part of the tube is covered by metal, the portion of the glass under it forms a terminal, and gas is driven from it, as I have shown it is for internal terminals. I have used cylindrical tubes with flat cathodes, in which the impact of the cathode stream was received on the glass wall of the tube, at the end opposite the cathode; the glass being covered at that place with thin aluminum-foil to act as an anode and yet permit the X-light to go forward without much absorption. In this tube the light not only goes forward, but spreads as spherical waves in all directions from every part of the glass struck by a cathode stream particle. When it is desired to limit the area illuminated or to send the beam in any given direction, the diaphragm which I illustrated in the *International Dental Journal* for July, 1896 (and in connection with direct-acting tubes, in the ELECTRICAL REVIEW for 1898), should be used in the form of a non-radiable tube enclosing the end of the X-light tube, which is inserted into the body cavity—the opening through which the light is to escape being closed by a radiable window, such as I have already illustrated in connection with a Tesla direct-acting tube—to allow the water to circulate without escaping. I have also lined the non-radiable sheath opposite the radiable window with a metal which reflects X-light. In other forms I have used a convex cathode to spread the cathode stream, that it might strike the walls of the tube over a considerable area and thus make the source of X-light a long cylinder, the whole of the part of the tube inserted into the body cavity, for example, if desired; for X-light arises wheresoever the cathode stream particles strike with great force. The same non-radiable sheath and zinc reflector are applicable to this form of tube, when it is desired to have a source of light which is directed to one side of the body cavity. In other cases I used a concave cathode to spread and not to concentrate the cathode stream, thus causing the light to arise from a large area, as with a convex cathode. I mention this chiefly to show that this is really the way the therapeutic tubes with concave cathodes of short curvature recently invented work; though such was not the intention of the inventors, as may be seen by examining the illustrations published of these tubes. When a cathode of short focus is placed in a long tube, the cathode stream is brought to a focus in the tube near the cathode, but far from the tube walls. Therefore the stream spreads again, there being nothing for it to strike and its impact is a diffused one over a large area of the inside of the tube, and from this large area the X-light arises and only a part of it from the end of the tube where it is supposed to arise. This should be kept in mind in designing such tubes. It does not seem worth while to burden this note with cuts of flat and convex target tubes, for these should be made for the cases in which they are to be employed. I have desired only to point out the principles to be followed. Physicians who wish to use such festive agents as ether waves and electrons in therapeutics need special training quite as much as surgeons and other specialists, and should have inventive and engineering faculties to enable them to design and construct their own apparatus, that progress may be rapid and their patients well served. Speaking of electrons reminds me that the subject of burns from X-light apparatus is not yet clear in the minds of some recent writers. I wish, therefore, to again state there are two sources of burns from such apparatus. In earlier notes it was proved that a burn could be produced from an X-light tube in which the resistance was so high that no X-light was being generated. This form of burn is due to electrons and can be made by radium. Perhaps I was the first to show that radium could be used in therapeutics when made into plasters and capsules. It is interesting to remember that radium gives both X-light and electrons. That burning can be produced with it, when a non-radiable substance (one of high atomic weight) is placed between the skin of the animal and the radium. In this case it is chiefly the electrons which do the mischief as they pass more readily through the substance than the X-light. I also published another experiment, in which the action of electrons shot from the X-light tube and other electric actions, except ether waves, were eliminated and yet blindness, burns, abortion and death were produced in animals by the X-light. This experiment has not received the attention it deserves as being the first in which electrons and other causes besides the short ether waves we know as X-light were ruled out. In all the earlier experiments there was a possibility that other causes besides X-light were acting, though some of these earlier experiments have been widely quoted.

The National Electric Light Association's Report of Municipal Lighting Statistics.

The confidential report of municipal lighting statistics, published by the National Electric Light Association, has been distributed to the members. This list is carefully prepared, and corrections are made from year to year, showing the population of towns and villages, the number of lamps contracted for, the price per lamp per year, the nominal candle-power of each lamp, the number of hours operated each year, the watts at lamp, the style of lamp—whether alternating-current or direct-current—the expiration of contract, the candle-power-hours for one cent, the price of steam coal, and the contract price of gas, either by common burner or Welsbach burner. This list has been so carefully prepared that, with all stations heard from, only one error of any importance was discovered. This list is secured only by members of the association.

PROCEEDINGS OF NATIONAL ELECTRICAL CONTRACTORS' CONVENTION.

(Continued from page 119.)

an ambulance and dump-cart drawn by a diminutive Shetland pony, and other absurd paraphernalia, were at the pier on the arrival of the boat. Immediately the president, Mr. Charles L. Eidlitz, a man of more than ordinary dignity, appeared he was hustled into the small dog-cart and driven to his hotel, at the head of the procession. On his little dog-cart was a large placard, "Our Dear President." The staid citizens of Detroit were startled on hearing the dirge music that the brass band gave out as it preceded this procession through the streets at an early morning hour.

The work of the entertainment committee was unusually effective and courteous and it was remarked by a great many that the hospitable and kindly atmosphere of Detroit had marked the gathering as a most happy meeting. Mr. F. J. Minor, of Detroit, chairman of this committee, was especially diligent. The ELECTRICAL REVIEW wishes to acknowledge the courtesy of the complimentary office, with furnishings and equipments, which was tendered to it in the exhibition hall during the meeting.

During the days of the gathering Mr. Joseph E. Lockwood, president of the Michigan Electric Company, kept open house at the company's new building, 75 and 77 Bates street, and entertained visitors with a luncheon daily.

The exhibition at the Light Guard Armory of electrical construction equipments and the special products which are made by manufacturers, was unexpectedly elaborate and attractive. It is estimated that 2,000 people a day visited the exhibition. The interior of the building was beautifully festooned and especially well lighted for decorative effects.

The following is a list of the manufacturers who exhibited and were represented:

L. B. Allen & Company, Chicago, Ill. Represented by Stuart S. Crippen.

Holtzer-Cabot Electric Company, Boston, Mass. Represented by E. R. Harding, manager Chicago office, and T. G. Meinema.

United States Incandescent Lamp Company, St. Louis, Mo. Represented by H. G. Ferguson, president.

National X-Ray Reflector Company, Chicago, Ill. Represented by E. L. Haines, general manager.

Benjamin Electric Manufacturing Company, Chicago, Ill. Represented by R. B. Benjamin.

Gould Storage Battery Company, New York and Chicago. Represented by E. L. Draffen.

Osburn Flexible Conduit Company. Represented by C. E. Corrigan, vice-president, and Calvin B. Roulet.

S. B. Condit, Jr. & Company, Boston, Mass. Represented by Fred W. Nason.

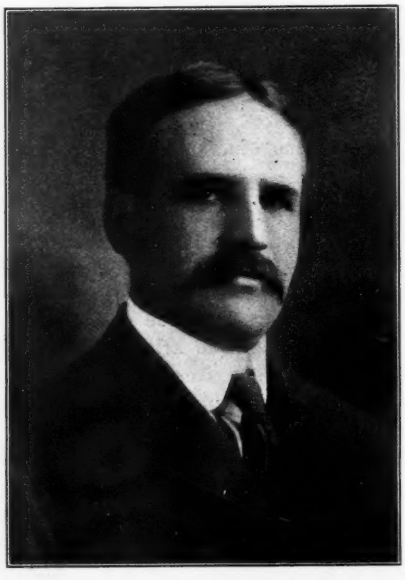
Fort Wayne Electric Works, Fort Wayne, Ind. Represented by A. L. Searles and Frank K. Ross, of the engineering department.

Anderson Porcelain Company, East Liverpool, Ohio. Represented by Howard H. Balliett.

The Fullman Company, Pittsburg, Pa. Represented by J. M. G. Fullman.

John Toler Sons & Company, Newark, N. J. Represented by Henry W. Cook.

The Dale Company, New York. Represented by O. J. Bryan and John Dale, president.



W. I. GRAY.
First Vice-President.

Marshall-Sanders Company, Boston, Mass. Represented by L. W. Kittman.

Maltby Lumber Company, Bay City, Mich. Represented by J. A. Maltby.

American Push-Button Telephone Company, New York. Represented by W. V. Sweeten, general manager, and William F. Van Benthuysen.

The Hart Manufacturing Company, Hartford, Ct. Represented by W. P. Crockett, manager Chicago office, and William Taylor, manager New York office.

General Electric Company. Represented by F. H. Gale, Schenectady, N. Y.; J. H. Livesey, manager Detroit office; F. N. Boyer, Chicago; William Hand, St. Louis, and P. L. Clark, Chicago.

The American Electric Heater Company, Detroit. Represented by President B. H. Scranton and Treasurer John Scudder.

The Crouse-Hinds Electric Company, Syracuse, N. Y. Represented by F. M. Hawkins, manager New York office; F. F. Skeel, Chicago; A. B. Hills and C. Snyder, Syracuse, N. Y.; C. T. Crofoot, Cincinnati, and M. Norden, New York.

The Norden-Bittner Company, New York. Represented by Mortimer Norden.

The Fuller Company, of Detroit. Represented by R. Fuller and F. Vollmer.

Patrick, Carter & Wilkins, Philadelphia. Represented by W. W. Winship.

National India Rubber Company, Bristol, R. I. Represented by P. T. Lyons.

Manhattan Electrical Supply Company, New York and Chicago. Represented by F. B. Pierce, of the Chicago office, and J. W. McDowell, of New York.

Michigan Nut and Bolt Works, Detroit, Mich. Represented by H. McLean and F. S. Bigler.

Carlton-Chase Electric Company, New York. Represented by Percy R. Frost and J. A. Vaughan.

Browning Manufacturing Company, Milwaukee, Wis. Represented by S. A. Dean and H. B. Wilkins.

National Carbon Company. Represented by E. J. Clyme and F. J. Kysefa.

F. Bissell Company, Toledo. Represented by F. Bissell and M. S. Walker.

Electric Gas Lighting Company, Boston. Represented by C. E. Lee and F. H. Sherman.

Allen-Hussey Company, Chicago. Represented by A. R. Hussey.

Sachs Electric Company, St. Louis, Mo. Represented by Gus Sachs.

Sawyer-Man Electric Company, New York. Represented by Clifford S. Jennings.

Yost Electric Manufacturing Company, Toledo. Represented by F. Harry Yost.

The Miller Anchor Company, Norwalk, Ohio. Represented by G. H. Miller.

Pass & Seymour, Inc., Solvay, N. Y. Represented by B. E. Salisbury, secretary and general manager; John W. Brooks, Chicago, and W. Brewster Hall, New York.

The Phelps Company, Detroit. Represented by W. J. Phelps, W. E. Phelps, J. Wiley Phelps and F. H. Funston.

Crescent Company, Chicago. Represented by J. H. McGill.

I. P. Frink, New York. Represented by Frank Stout.

DeVeau Telephone Manufacturing Company, New York. Represented by

V. C. Gilpin and A. S. DeVeau, president.

The Cutter Company, Philadelphia. Represented by George L. Crosby, manager Cleveland office.

Thomas E. Clark Wireless Telegraph-Telephone Company, Detroit. Represented by Thomas E. Clark, Gustav F. Reissthal and Ackland Stiling.

Sprague Electric Company, New York. Represented by Alex. Henderson, of New York, and E. B. Kittle, Chicago.

The Bossert Electric Manufacturing Company, Utica, N. Y. Represented by F. T. Foxenberger and C. Nollitx, Cincinnati.

The Elblight Company of America, New York. Represented by Russel Spaulding, Eugene H. Abadie and Harry Shafer.

Westinghouse Electric and Manufacturing Company. Represented by Charles F. Medbury, manager Detroit office; A. L. Rathbone and W. C. Armstrong, of Detroit.

Johnson & Morton, Utica, N. Y. Represented by W. H. Morton.

Alphaduct Manufacturing Company, New York and Chicago. Represented by William M. Porter and M. Minchener.

American Circular Loom Company, Chelsea, Mass. Represented by Sales Manager H. B. Kirtland; R. B. Corey, New York; Thomas G. Grier, Chicago; J. L. Kirtland, New York, and Thomas Bibber, Boston.

H. L. Walker Company, Detroit. Represented by H. L. Walker, president, and William J. Hartwig.

Nernst Lamp Company, Pittsburg. Represented by T. H. Bailey Whipple, sales manager, and A. E. Fleming, manager Chicago office.

United Electric Heater Company, Detroit. Represented by R. Kuhn and F. Kuhn.

Harrison Safety Boiler Works, Philadelphia. Represented by F. T. Mason, of Detroit.

American Conduit Manufacturing Company, New Kensington, Pa. Represented by C. A. Flack.

The John A. Roebling's Sons Company. Represented by F. W. Harrington, New York; C. B. Cushing and G. W. Swan, Trenton; W. P. Bowerman, W. H. Richardson, W. W. Afflack and J. W. Brooks, Cleveland.

Atlantic Insulated Wire and Cable Company, Stamford, Ct., and New York. Represented by George F. Porter.

Sterling Electric Manufacturing Company, Warren, Ohio. Represented by W. C. Osborne.

Valley Brothers Electric Company, Cleveland. Represented by D. B. Scarborough.

Westinghouse-Church-Kerr Company. Represented by H. J. Raynor, Detroit.

Chase-Shawmut Company. Represented by Harry P. Moore.

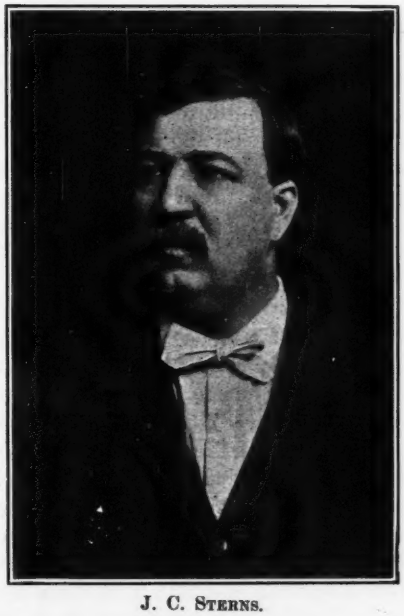
H. W. Johns-Manville Company. Represented by H. S. Finney, Chicago.

Adams-Bagnall Electric Company,

W. H. MORTON.
Secretary.

Cleveland. Represented by J. G. Pomeroy, manager Chicago office.

M. B. Austin & Company, Chicago. Represented by M. B. Austin.



J. C. STERNS.
Sergeant-at-Arms.

A. L. Doxsee Electric Company, St. Louis. Represented by A. L. Doxsee.

W. R. Ostrander Company, New York. Represented by H. E. Monk.

The Jewell Electrical Instrument Company, Chicago. Represented by Edward W. Jewell, president.

The Peru Electrical Manufacturing Company, Peru, Ind. Represented by President Bouslog and George S. Searing, manager Chicago office.

Duncan Electrical Meter Company, La Fayette, Ind. Represented by W. H. Sinks.

American Electric Fuse Company, Chicago. Represented by George W. Rodomer.

Kuhlman Electric Company, Elkhart, Ind. Represented by E. Kuhlman.

Western Electric Company. Represented by Major Robert Edwards; L. G. Baldwin, St. Louis; S. W. Cobb, Cleveland; E. F. Field, Detroit, and E. S. Keefer, New York.

American Electric and Novelty Manufacturing Company, New York. Represented by J. W. Lecky, Chicago.

Michigan Electric Company. Represented by President Joseph E. Lockwood, H. Cameron, Edward Bullock, S. R. Fralick and others.

The Miller-Selden Electric Company, Detroit. Represented by W. H. Sheldon, Jr., D. F. Seidler and A. Miller.

Minnesota Electric Company, Minneapolis. Represented by W. J. Chapman.

Kohler Brothers, Chicago. Represented by C. R. Krider.

New England Engineering Company, Waterbury, Ct. Represented by Harvey E. Paige.

Edwards & Company, New York. Represented by P. C. Haviland.

National Electric Supply Company, Washington, D. C. Represented by E. C. Graham.

Resignation of Mr. Calvin W. Rice.

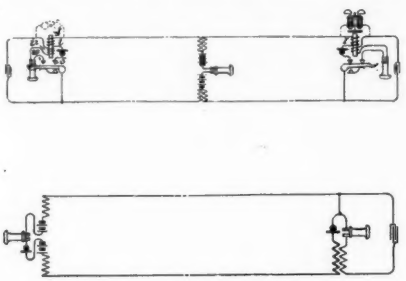
Mr. Calvin W. Rice, of the Nernst Lamp Company, of Pittsburg, Pa., has announced his resignation from the company, to the universal regret of his business associates, who found in him that combination of executive ability and personal popularity so much to be desired.

Since May, 1902, Mr. Rice has held the position of second vice-president, to which he later added the duties of sales manager. To his efforts is due much of the success of the company and its present substantial commercial standing, the past year having been a particularly successful one.

Mr. T. H. Bailey Whipple, who has been associated with the Sawyer-Man Electric Company as assistant to the second vice-president, succeeds Mr. Rice in the Nernst Lamp Company. Mr. Whipple, who was formerly connected with the Jandus Electric Company, of Cleveland, Ohio, is a man of wide experience and acquaintance in the electric lighting field, and eminently fitted for the position which he assumes.

Electrical Patents.

The American Telephone and Telegraph Company, of New York, has purchased from Mr. Almon B. Stetson, of Malden, Mass., a patent on an improved substation telephone circuit. This invention relates to variable resistance transmitters and their operation, and especially concerns substation or subscribers' station circuit arrangements for instruments of this character by means of which the disturbing effects which tend to be exercised by such transmitters on the associated receiver or receivers at the same station may be prevented or at any rate greatly reduced. Sensitive and powerful transmitters, such as are now employed, not only reproduce the desired sounds or words in the receiver at the distant station, but also produce an echoing or resonant sound, colloquially termed the "side tone," in the associated receiver at the same or transmitting station. Moreover, in the operation of central source telephone exchanges involving toll or interurban lines it is often desirable in the interest of efficiency to supply the substation transmitters with working current under higher voltage than has ordinarily been employed, and under such conditions the microphonic action is materially intensified, so that in addition to the side tone there is present an increased tendency to create and manifest in the home receiver buzzing and crackling noises and sounds, as well as to take up and reproduce all such sounds as are being produced in the immediate proximity of the instrument. The noise in the ear of the person using the telephone becomes under these circumstances so loud as to be both unpleasant and confusing and operates to disturb and disconcert the user, making it very difficult for him to follow the conversation or intelligently receive the message. To reduce such side tone and other disturbances to the lowest possible point and generally to prevent the disturbing effects attributable to undesigned or abnormal action of the transmitter from manifesting themselves in the associated or home receiver, and to effect this without materially reducing the volume of transmission, are the objects of this invention. Attempts have heretofore been made to attain some of these objects by specially designed induction coils with associated balancing resistances, but such arrangements while fairly satisfactory with transmitters of moderate power operating under the local battery conditions shown in said patents are not completely successful under present conditions and apparently are not of a character capable of improvement or further development in such manner as to meet such prospective conditions as are now in sight. In the modern practice of a common and central battery exchange the substation apparatus comprises the call-bell, the telephone transmitter and an associated induction coil, the telephone receiver, the regular suspension-switch, serving as a support for the receiver when unemployed and operating by the displacement and replacement thereof, and a condenser. When the switch is in its normal or resting position with the receiver suspended upon the hook, the circuit is through the call-bell and condenser, such circuit in virtue of the inclusion in it of the said condenser preventing the passage of the steady current of the central station battery, but readily permitting the operation of the polarized bell by the alternating currents of the central station call-generator. When now the receiver is taken from the hook for

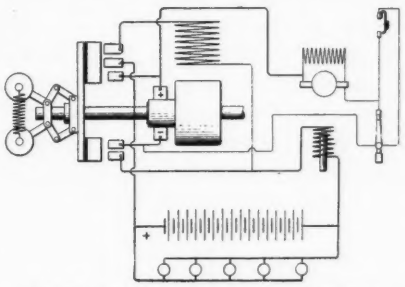


Substation Telephone Circuits.

use and the switch in consequence moves to its second and working position, the telephone circuits of the substation are brought into operative relation with the main or line circuit and the central source of current. Until recently the substation telephone circuit arrangement thus established has been substantially that of the United States patent to Charles E. Scribner, No. 669,710, of March 12, 1901. In this system (the switch being, as assumed, in its second position) the main circuit is conductively closed through one winding of the induction coil, and a local transmitting circuit is established which contains the telephone receiver, the condenser and the other winding of the induction coil. The transmitter is placed in a section of conductor which is common to and forms a part of both circuits and is therefore itself connected both in the local and main circuit; but its direct action is nearly altogether restricted to the local circuit, its effect upon the main circuit and the distant receiver being mainly exercised through the associated induction coil. The source of transmitter current is in the main circuit at the central station, and when the said main circuit is closed at the substation by the action of the switch in moving to its second position, as stated above, there is developed a steady current which flows through the main line, the substation transmitter and the main circuit winding of the induction coil. Differences of potential between the two sides of the transmitter are determined by the resistance variations produced in the operation of said transmitter, and as a consequence waves or surges in the local circuit, which circulating in the second winding of the induction coil induce similar currents in the first winding thereof, and these flowing through the main circuit act upon the distant receiver and cause it to reproduce the sound whereby the transmitter was originally actuated. In many respects the foregoing operative arrangement for the telephone circuits of substations is highly efficient; but it has a serious disadvantage in that it is subject in a high degree to the side-tone fault, which the present invention aims to prevent or remedy. In the present invention the transmitter is removed from that section of conductor which is common to both main and local circuits, being thus entirely separated from the circuit which contains the receiver, and consequently from the receiver itself, being placed instead in the main circuit alone, together with one winding of the induction coil. This change is the cardinal feature of the invention and is productive of decided advantage, since by it the unpleasant and annoying side tone is practically done away with without material loss in the volume or quantity of transmission. The invention as organized in a subscribers' or substation telephone apparatus or system of circuits thus comprises the main circuit or that part or loop thereof which is within the station, an associated local circuit wholly within said substation and an induction coil and condenser, one winding of the induction coil, together with the station telephone transmitter being serially arranged in the main circuit-loop, while the receiver and condenser are similarly connected, together with the other winding of the induction coil, in the local circuit. The invention also consists in associating the organization thus constituted with the telephone switch, the switch being placed in a section of conductor common to the main and local circuits and being thereby adapted to control them both. It further consists in combining the entire substation apparatus as thus constructed

and organized with the telephone apparatus and common source of current of the central station, these being connected with the same main circuit, and likewise in a combination of a talking circuit extending between two substations through a central station, the several instrumentalities at both substations being arranged in conformity with the characteristic features of the invention as stated above, and the talking circuit being made up of two component circuits independently supplied with transmitter current developed from a source of current located at the central station.

An improvement in automatic regulators for electric generators has been patented by Mr. William A. Turbayne, of Buffalo, N. Y., who has assigned his interest to Mr. Charles M. Gould, of New York city. The invention is an improvement on a regulator patented by Mr. Gould in 1902, this regulator being particularly employed in connection with an electric lighting apparatus for railway cars, in which the electric current is generated by a dynamo mounted under the car and driven from one of the axles by a belt or the like. As the speed of the car axle has a considerable range of variation, it is desirable in order to maintain a practically constant output of the dynamo to drive its armature at a practically constant speed. Briefly stated, this is accomplished in the original patented device as follows: The dynamo is mounted to move toward and from the driving car axle, and an electric motor and connections are provided, which move the dynamo toward the car axle to slacken the driving-belt, so that it will slip and decrease the speed of the dynamo-armature when the speed of the car axle is greater than necessary for the normal operation of the dynamo and which move the dynamo in the opposite direction to tighten the belt when the speed of the car axle decreases to or below the speed required for the normal operation of the dynamo. The motor is driven in one direction by a current from the dynamo, and a reversing mechanism actuated by a solenoid is provided for determining the direction of movement of the dynamo. The solenoid is controlled by a current generated by the dynamo and operates the reversing mechanism to change the direction of movement of the dynamo when the output of the dynamo rises above or falls below a predetermined normal value. If the car axle rotates at an abnormally slow speed for a considerable time—as, for instance, when the car is moving slowly for some distance—the dynamo might be moved so far away from the driving car axle as to stretch or break the belt or injure some other part of the apparatus. If, on the other hand, the car axle is rotated at an abnormally high speed for a considerable length of time—as, for instance, when the car is run very rapidly for some distance—the dynamo might be moved so near to the driving car axle as to entirely stop the rotation of the dynamo-armature or injure or break some part of the apparatus. The object of the present invention is to provide a simple mechanism whereby the motor for shifting the dynamo is thrown out of operation before



AUTOMATIC REGULATORS FOR ELECTRIC GENERATOR.

the dynamo has been moved in either direction to such an extent as to interfere with the proper operation of the apparatus. This is accomplished by introducing into the electric circuit for operating the motor a limit-switch, which is operated by the shifting dynamo-carriage to break the motor-circuit and stop the motor before the dynamo has been shifted too great a distance in either direction.

The Northwestern Storage Battery Company, a corporation of Illinois, controls a patent recently issued to Mr. William Gardiner, of Chicago, on a new method of preparing electrolytes. Mr. Gardiner thus describes his invention: In electric storage or secondary batteries of that type in which caustic potash or caustic soda in solution is used as the electrolyte and in which one of the electrodes is a support on which zinc is deposited one great disadvantage is the weight and bulk of the electrolyte. Such an electrolyte has been heretofore produced by dissolving an oxide of zinc in a solution of hydrate of sodium and hydrate of potassium. A solution of hydrate of potassium or hydrate of sodium is capable of dissolving but a relatively small quantity of the oxide of zinc, and in order to obtain a secondary battery of this character having any considerable capacity it has heretofore been necessary to employ in each case an exceedingly large quantity or volume of solution. This has made such secondary batteries very heavy and bulky in proportion to their effectiveness. In carrying out my invention I use suitable electrodes. Any of the well-known electrodes employed in this class of battery, however, may be used, such as oxide of copper, for example, as the negative electrode and a support of copper gauze or iron gauze upon which the zinc is deposited in the charge as the positive electrode. I produce my improved electrolyte by means of a strong solution, preferably of pure caustic potash, in which I dissolve pure oxide of zinc made by the wet process. This solution is placed in the cells of a battery having suitable electrodes and subjected to a charging current in the well-known way until the greater portion of the zinc contained in the solution is deposited upon the positive element. The solution is then removed from the cells and is placed in a suitable receptacle for holding it temporarily. Oxide of zinc is then again dissolved in this solution and the solution replaced in the same cells as before and a charging current applied and the zinc deposited as before. This may be repeated and the process continued until zinc sufficient to equal the capacity of the desired battery is deposited or accumulated upon the positive electrode. When a sufficient quantity of zinc is deposited upon the positive electrode, the solution used to dissolve the oxide of zinc may be removed and a strong, fresh solution of pure caustic potash and water containing no zinc oxides substituted. The battery is then in readiness for discharge and charge in the performance of work. During the discharge the zinc accumulated upon the positive electrode in the prior charges dissolves or is taken up in the solution, so that after the discharge is completed a far greater quantity of zinc is dissolved or contained in this solution than could be possible by the old process, which consists in dissolving an oxide of zinc in this same solution before placing it in the battery. Inasmuch as the excessive bulk and weight of the ordinary battery of this type are caused by the capacity of the alkaline solution ordinarily to take up, absorb, or otherwise contain but a relatively small quantity of oxide of zinc, necessitating a large quantity of solution for any battery having any considerable output, it is obvious that by the method described an electrolyte for this type of battery may be obtained which is very much reduced in weight and bulk, primarily because a sufficient quantity of zinc for a given capacity of battery cell may be deposited in the charge upon the positive element and dissolved into the solution on the discharge. Obviously, also, a cell containing an electrolyte of the class described may be very much more quickly charged than in the ordinary cell of its kind, inasmuch as the electrolyte contains a great excess of zinc which is held in solution in an unstable condition and which is therefore deposited almost immediately when the charging current is applied.

Reviews of Current Engineering and Scientific Literature.

A Fan Dynamometer.

This article describes an ingenious and simple absorption dynamometer constructed on the principle of a rotary fan. The dynamometer was designed and developed by Colonel Renard, and has been used in testing motors at speeds of from 600 to 1,500 revolutions per minute, developing from seven to sixty horse-power. For the smaller sizes the dynamometer is coupled directly to the motor shaft. For the larger sizes a special bearing is built for the machine. The machine itself consists simply of a horizontal shaft attached to the centre of an ash rod. To the latter are bolted two aluminum planes which act as fan blades when the shaft revolves. The power absorbed by this dynamometer is proportional to the cube of the angular velocity of the planes. To change the load on the motor, the distance of the planes from the axle may be changed, or planes of different sizes may be used. This gives each dynamometer a fairly wide range. The brake is calibrated experimentally, and it has been found that the power of brakes of different sizes, but geometrically similar, varies as the fifth power of their ratio. In use the brake is extremely simple and it maintains a constant load on the motor indefinitely, as there is nothing to heat. Moreover, after a brake has been calibrated, a reading of the speed is sufficient to give the output of the motor. This dynamometer has been used by the inventor in shop tests for the past five years, and has been found very satisfactory.—*Translated and abstracted from L'Industrie Electrique (Paris), June 25.*

Systems of Mains Laying.

Systems of laying conductors under the ground are becoming of greater importance every year. In this article, Mr. F. H. Davies gives an outline of the various systems in use, pointing out briefly the advantages and disadvantages of each. The subway system, the author considers to be in many ways the best. The chief advantages of this are accessibility and safety from mechanical injury to the wires. He holds that there can be but little doubt that the subway system is bound to become general. The first conduit system consisted of a trench in which bare copper strips were carried on insulators, the trench being covered over in some way. This system is somewhat costly, but can be increased in size easily. In more recent types, the conductor is insulated and laid in an iron or earthenware conduit. In pipe systems, either iron or earthenware pipes may be used. This system is more flexible than the conduit system. Laying directly in earth is the cheapest and most flexible method, and this is particularly suitable where there is no danger from mechanical injury. The nature of the soil must, however, be considered carefully, as this may corrode the lead sheathing. In this system, house connections are easily made. The solid system, in which the conductor is laid in a trough which is then filled with some higher insulating compound, is coming greatly into use. It has practically the same advantages as a direct laid system, is cheap and flexible. The cable should be plain lead-covered, not braided. The trough should be protected from mechanical injury by bricks or other hard material. In speaking of boxes, the author urges that they be made amply large in the first case, as this costs but little more and is far more satisfactory.—*Abstracted from Electrical Engineering (London), June 19.*

New Material for Simple Alternating Currents.

In this paper M. Marius Latour discusses the advantages of single-phase alternating-current distribution over polyphase, and shows how the former may be used for power distribution by means of the new types of induction motor. The author first says that the usual figures given for the economy of the three-phase system are fallacious and that the advantage should be given to the single-phase system, for the latter, in addition to its simplicity, will require no more copper if the difference of potential between each wire and the ground is the same as that in the three-phase system. The author then considers single-phase alternating-current motors, reference being made to the series motor, the objection to this motor being that it can not be used on high potentials because of the commutator, the rather poor power-factor, and that the stator is not heated equally at all points. The action of the Latour motor is then described. This motor is similar to the ordinary induction motor, except in the addition of a commutator to the secondary, upon which brushes connected together are placed. The action of this device is described, being shown how the motor becomes not only self-exciting with a power-factor as high as desired, but self-starting, and the speed may be regulated. A description is then given by M. Gratzmuller of the behavior of a motor constructed on this principle, characteristics and curves of current and electromotive force being shown. The latter demonstrate that the current is practically in phase with the applied electromotive force, but that the wave is slightly flattened at the peak. The motor is a two-pole machine operating on a frequency of twenty-five. The full-load efficiency was eighty-four per cent.—*Abstracted and translated from Bulletin De La Societe Internationale des Electriciens (Paris), June.*

An Experiment on the Change of Weight of Radium with Time.

The results of the test made by Herr Heydweiler, published some time since, that a preparation of radium furnished by Haën lost in weight daily 0.02 milligramme, inspired Herr Ernst Dorn to test this matter himself. In December, 1902, he enclosed in a small tube 29.9 milligrammes of very active "pure" radium bromide supplied by Buchler & Company. The tube was of alkali-free Jenaer glass, six centimetres long, with an outside diameter of 0.46 centimetre and a thickness of glass of 0.3 millimetre. The tube was closed by fusing. A counterweight was prepared of an equal length of the same glass tube, filled with sand, and also closed by melting. Both tubes were fitted with hanging eyes of equal lengths of the same platinum wire. The weight of the tubes amounted to from 1.1084 to 1.1088 grammes. For weighing the tubes were hung on the hooks of a balance beam. During the weighing the tubes came into contact with no foreign body except the ivory tweezers used in handling. For interpolation, a platinum milligramme weight was used and kept under a double bell glass. The balance was fitted with a reading mirror, and its sensitiveness varied somewhat with the temperature. It was set up in a large, arched, quiet room, with a stone floor, upon a brick table with a slate top. The reading telescope was set up on a seasoned hardwood stand. The balance was surrounded by a double walled box of bare zinc, with but one opening, that for observation. This was fitted

with glass. The scale was lighted by a beam from an incandescent lamp, the balance being carefully shielded. To prevent disturbances, due to static charges, two tubes filled with radium chloride were placed under the balance box during the spring. Hydrometric observations were made during the weighing. The latter were made by the swinging method. An illustrative example is given. In every case the observations show that a loss of weight of more than 0.001 milligramme in about three months did not occur, while according to Heydweiler's result, obtained upon 5,000 milligrammes, the quantity of radioactive material here used should have shown a loss in ninety days of 0.011 milligramme. To test the relative activity of the two materials, that used by the author in this work and that used by Heydweiler, were compared by an electroscope, according to the method of Elster and Geidel. The results showed that Dorn's material was much more active than that used by Heydweiler.—*Translated and abstracted from the Physikalische Zeitschrift (Leipsic), July 1.*

The New Electricity Works of the Manchester Corporation.

In the second section of this serial, which describes in detail the Manchester works, are given particulars of the power plant and substations being erected after the designs of Mr. G. F. Metzger, the city electrical engineer. The first instalment of this scheme comprises a generating plant of 12,000 horse-power, but the buildings are designed to accommodate twice this amount. The steaming plant will consist of twelve Babcock & Wilcox boilers, each capable of evaporating 20,000 pounds of water per hour. These are provided with automatic stokers and superheaters. The generating plant will consist of two 3,750-kilowatt sets, each comprising a 6,000 indicated horse-power, vertical, triple-expansion, condensing engine, running at seventy-five revolutions per minute, and a three-phase alternator working at 6,500 volts, fifty cycles. The engines will be supplied by the Wallsend Slipway and Engineering Company. These engines will have four cylinders, with four cranks each, and work at 190 pounds pressure at the stop valve with superheated steam. The generators will be supplied by the Electrical Company, Limited, and will be of the revolving-field type, with the poles mounted on the periphery of a flywheel weighing 160 tons and twenty-seven feet in diameter. This station will supply power to ten substations, which will be much alike in design and equipment. The equipment will consist of four 150-kilowatt motor-generators and one 100-kilowatt motor-balancer. Provision is made for extensions with large units of 300 kilowatts each. These sets consist of three-phase synchronous motors, receiving current direct at 6,500 volts, coupled to a six-pole dynamo, giving 375 amperes at from 400 to 550 volts. In addition to these substations there are ten others, erected in connection with the plans of Dr. A. B. W. Kennedy, and supplied from the power-house which is described in the abstract of the first of these articles in the ELECTRICAL REVIEW of July 18. The motor-generator sets are similar to the ones just described, but have a capacity of 220 kilowatts. The dynamos of these sets are supplied with slip rings, to which are connected inductance coils, making each dynamo self-balancing, in addition to the balancing set. At the Dickinson street station were installed recently two 900-kilowatt Parsons steam turbines. These run at 1,040 revolutions per minute, and each drives two generators. This station also contains two Musgrave-Siemens and Musgrave E. C. C. steam dynamos, each of 1,500 kilowatts output.—*Abstracted from the Electrical Review (London), July 3.*

On Induction Machines and a New Type of Polyphase Generator.

This is the first half of an article by Mr. A. C. Eborall, and in it the author gives a short account of the polyphase generator designed by Alexander Heyland, with some remarks relative to its development. These generators are synchronous, although the operation of their fields is of the nature of that of asynchronous machines. They are self-exciting, and are scientifically and properly compounded, not only with regard to the magnitude of the current, but with regard to its character. In the standard induction motor the large wattless component of the stator current is due to the fact that the magnetic flux is produced by magnetizing the currents of the full frequency circulating in the stator winding. The magnetizing current in the best modern motors of normal design is of the order of twenty per cent of the full-load current, and consequently the volt-ampere input of the motor at no load is of the order of one-quarter of the apparent input at full load. The excessive amount of apparent energy required by the standard induction motor for the production of its magnetic flux is due to the high frequency of the magnetizing current, where a few volts would get this current through the stator windings if it was a direct current. It actually requires the full supply pressure. Nearly the whole of the applied pressure is required to balance the counter-electromotive force set up in the stator windings, and it is clear that if this back pressure could be done away with the magnetizing watts would be almost inappreciable. This has been accomplished by Heyland, who supplies a magnetizing current to the rotor, having the low frequency of the rotor currents. These currents are supplied to the rotor through a commutator, the segments of which are connected to the rotor conductors, and are also short-circuited by low-resistance conductors which, while lengthening the commutator a small amount, make no appreciable difference in its cost. The low-resistance connectors to the commutator bars short-circuit the rotor winding, prevent the current from being broken at the brushes, reduce the amount of current under the brushes, and take up the pulsation in the rotor current, and hence in the magnetic flux. The commutator brushes are so placed relatively to the stator that the converted magnetizing currents in the rotor bars have exactly the same direction as the corresponding stator currents, which these rotor magnetizing currents have to replace. The position and synchronous rotation of the magnetic flux are determined by the position of the brushes, and are independent of the speed of the rotor. The stator current of such a compensated motor is a pure energy current after the current led to the brushes has once been properly adjusted. In a properly adjusted compensated motor the power-factor is unity at all times. In the compensated motor the rotor flux is equal to the stator flux, plus the leakage flux, and an increase of magnetic leakage simply means that the rotor flux must be correspondingly increased. This is not objectionable, since the rotor iron losses are, in any case, small, and deepening the rotor slots to get in more copper produces no ill effects. When this compensating device is added to an induction generator it becomes self-exciting. The only difference between the compensated induction generator and the compensated induction motor is that the former requires relatively a little more excitation. The generator may be compounded or over-compounded for simple and inductive loads by passing the main stator current, or a portion of it, through the short-circuit rotor, in addition to the compensating current. When operated as a generator a small synchronous machine must be connected to the same circuit to fix the frequency.—*Abstracted from the Electrician (London), July 3.*

BOOK REVIEW.

"Telephony." Arthur Vaughan Abbott. New York. McGraw Publishing Company. In six volumes. First three volumes now ready, Part I—The Location of Central Offices. 170 pages. 33 illustrations. Part II—The Construction of Underground Conduits. 190 pages. 62 illustrations Part III—The Cable Plant. 152 pages. 51 illustrations. Supplied by the ELECTRICAL REVIEW at $1.50 per volume; the set complete (if ordered together), $6 00. Uniform cloth binding.

The first volume of this series is devoted to the method of selecting central office location (or locations, if there is to be more than one central office), a discussion of the necessary trunking facilities, mileage of same, etc. The functions of an exchange are given in chapter i in a general way, and chapter ii is devoted to explaining the meaning of terms most commonly used for designating the various parts that go to make up the central office. Six chapters are then devoted to the self-evident fact that the location of the central office which will require the least wire mileage is that location which falls at the intersection of two straight lines drawn perpendicularly to each other following the street lines, being so located that there will be as many substations on one side of each line as on the other. The author then passes on to determining the necessary number of trunk circuits and the trunk wire mileage where more than one office is to be established, and finally evolves, at the end of the chapter, the equation $R = q \frac{(ST - S^1 T^1)}{ST}$. This equation represents the ratio of the number of outgoing trunk calls to the total number of originating calls, and in it q represents an "acquaintance" factor, which depends for its value upon the social and business relations of subscribers connected to different offices; S represents the total number of subscribers in the system; T the average number of originating calls for a substation per day in the system, and S^1 and T^1 the same, respectively, for any particular office. Here we have one equation for solution, with several unknown quantities, none of which can be determined until the exchanges are built and the peg counts are made. The author gives approximate values for these unknown quantities which may have held true for Chicago—in which city the author has probably collected his information—but are not borne out in other places. The equation represents the percentage of the total number of originating calls in any particular exchange which are outgoing trunk calls, such trunk calls being destined to any other exchange in the entire system. But what are we going to do with such an equation if we want to determine the number of calls from your north exchange to your south exchange, or from your north exchange to your west exchange? It is unquestionably true that good judgment can be used in designating the number of trunks from any exchange to another exchange, which will not be far wrong, but equations are of no value in such determinations.

The system described in this volume for the operation of the trunks is hardly up to date. In the best modern boards the B operator never rings a subscriber—she hasn't time. The A operator tests the subscriber's line for "busy," does the ringing through the trunk, and supervises the connection.

In the second volume a rather complete general description of underground conduit construction is given, but the prices and costs look as though they were made up from data gathered some years ago, and are far from being correct or reliable. The cost to-day of such work is considerably in excess of the figures given, on account of the increased cost of both labor and material, and although the author asserts in chapter xcvi that "the cost of conduit construction is constantly and steadily decreasing, owing to improvements and cheapening in the manufacture of materials employed, natural competition tending to decrease price, etc.," yet the fact is that "natural" combinations of manufacturers, labor unions, and the great demand for supplies of all kinds have served to increase the price of both material and labor all along the line, and the cost of such work is higher to-day than ever before.

In speaking of the advisable distance between manholes, a distance of 500 feet between them as recommended is too great, as by the adoption of cables carrying from 400 to 600 pairs, as is now being practised, shorter distances are necessary, as cables of the size mentioned would not well stand the strain, nor their lead sheath the wear in a pull of this distance. As regards the advisability of placing concrete at the sides and on top of the ducts, or not to do so—the estimated sum of $78,000 was saved in the construction of an underground system which has come under our observation recently, and the company for which the system was installed has never paid out one cent in repairs for damage due to careless street excavation for over a period of three and one-half years. There have been two cases of damage reported and repaired, in the nature of pick holes, in one instance damaging a cable, but the cost of the necessary repairs was promptly paid by the company whose employé caused the damage in each instance, and about half a dozen telephones were out of service for a period of twenty-four hours. In the system referred to the only covering of the ducts on the sides and top consists of cement mortar plastered on one-half inch thick.

In Vol. iii, entitled "The Cable Plant," the general description of manufacture and methods of installing, splicing and terminating is rather complete. The prices and costs, as in the former volumes, are not up to date. In the "contract and specifications for cable construction" (section twenty-three), it does not seem advisable to allow the contractor to use either single or double-wrap insulation. A double wrap wound on each wire in reversed layers costs little more, and is well worth the difference by reason of the additional assurance against crosses, and because it gives a more substantial body to the cable, and enables it to be handled with less danger of buckling. In cables of 200 pairs or over single wrap is necessary to keep the capacity within reasonable limits. In these same specifications it would also be well to specify the length of time of charge and exact voltage in making insulation and capacity tests. The practice of putting two or three per cent of tin in a lead sheathing is being abandoned, and, so far as the reviewer knows, no manufacturer can give a good reason for its use, except that it had always been used, until some one in the last few years called for commercially pure lead in his specifications. The earliest forms of paper-covered cables were made up by drawing the core into a lead pipe, and this pipe was then stiffened by an admixture of about three per cent of tin, so as to enable the manufacturer to draw the core in without bending the pipe. A sheath of commercially pure lead reduces the first cost, and the cable will last just as long. The author, in section twenty-seven, gives outside dimensions for 400-pair cables which would bar the use of that size in the underground systems as built to-day, in which the ducts would run about three and one-quarter inches in diameter; but fortunately the cable manufacturers make it with the same conductor resistance and capacity as called for by the author, and with a diameter outside of less than three inches.

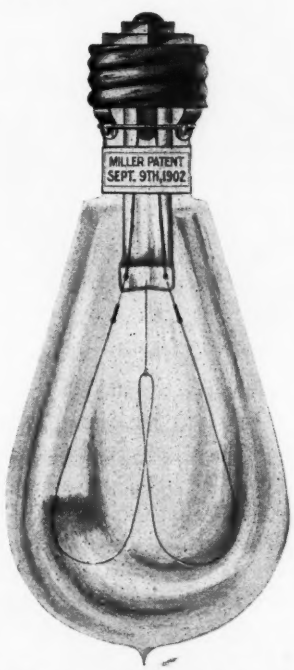
In all of the three volumes received the prices and costs of materials and labor are given in too general a way. Costs, to be of any value, should be expressed in time units. For instance, to say that the cable splicer and helper will make one splice in a 2,200-pair cable in ten hours gives such information as can always be used, and simply requires adjustment of the schedule prices of labor; and the same thing is true of materials—they should be given in quantities. Tables and curves of costs are valueless in these days of rapidly changing prices, as one instance will illustrate—previous to this spring multiple tile conduit was laid by common labor; now this can not be done (in some sections of the country, at least) as the masons have ruled otherwise.

INDUSTRIAL SECTION.

ILLUSTRATED DESCRIPTIONS OF NEW AND STANDARD ELECTRICAL AND MECHANICAL APPARATUS.

A New Type of Incandescent Lamp.

The Missouri-American Electric Company, St. Louis, Mo., is placing on the market a new type of incandescent lamp for which a number of special features are claimed. The chief feature of this lamp is in the attachment of the bulb to the socket. This is a radical departure from the ordinary type. The locking device is entirely mechanical, and the accompanying illustration will give a good idea of the method in which this is accomplished.



NEW TYPE INCANDESCENT LAMP.

The metal cap is slipped over the stem of the lamp, and a porcelain plug is seated under the brass cap. One lead is drawn through the porcelain plug and soldered to a button which is slightly raised above the flanges on the porcelain plug. By means of a special cement this button is fastened to and becomes a part of the stem of the lamp. The other lead is carried alongside of the stem of the lamp, between the stem and the brass cap, and attached by a drop of solder to the cap. A brass tie-wire holds the cap, by means of four projections, to the stem of the lamp, the drop of solder which is part of the connection of one of the filament leads securing this permanently. This method of attaching does away entirely with the use of plaster of Paris and cements.

The manufacturer states that with this type of lamp, if a renewal is desired, the old bulb may be cleaned and fused to the base, or a new bulb may be fused to the base, as desired, in any case making a clean saving of the cap, button, stem and the platinum leads.

The company's purpose is to place on the market a lamp of the highest quality. It has equipped a plant at St. Louis with the most modern machinery and instruments, and states that its method of construction will be such as to produce the very best results. The Edison base is furnished with these lamps, and as the demand justifies it other types will be adopted. For the present the output will be fitted with the Miller patent Edison base. The anchored oval type of filament is used, but coil filaments will be fitted wherever specified.

A General Engineering Company.

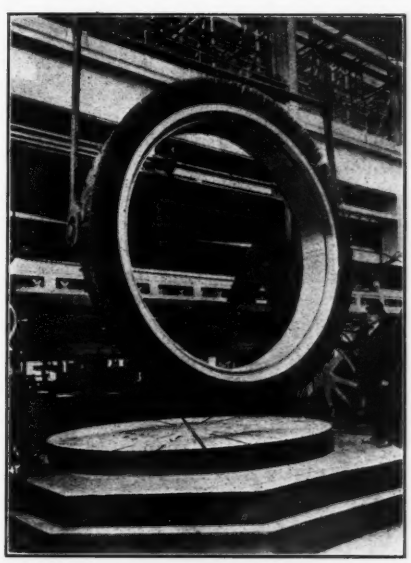
Articles of incorporation have been filed with the Secretary of State at Springfield, Ill., for the Cosmos General Engineering Company, with principal offices in the Fisher Building, Chicago. This company proposes to do general, consulting and contracting engineering in all of its branches and will sell any and all kinds of machinery. The officers and principal stockholders of the company are men of wide experience as engineers and business men, and while all of the business will be conducted under one general management, each individual department will be represented by a man who has built up a reputation for himself in his special branch of engineering. Therefore, any one desiring to obtain any certain results and not knowing his exact needs, will have only to write to the general office of the company explaining fully just what is required and he will be informed at once what is necessary to reach the best results in the shortest time, as well as the total cost of the same. In that way anybody wishing for information on a given subject will not have to go to the expense and trouble of experimenting or spending a lot of valuable time in corresponding or hunting for the information desired.

Offices will be established in all of the leading cities so that there will be as little delay as possible in attending to the wishes of its customers.

A Large Commutator.

The accompanying engraving illustrates the assembly of a commutator which is to form part of an 1,800-kilowatt, direct-connected generator under construction in the shops of the British Westinghouse Company, Manchester. The generator is being supplied to the order of the City of London Electric Lighting Company, and will be run in conjunction with units of similar size already supplied by the company, and working at the Bankside station. The external diameter of the commutator is ten feet, and there are 900 segments, each of hard-drawn copper, around the circumference. The generator is designed for a normal output of 1,800 kilowatts at 450 to 500 volts, and will be capable of supporting a continuous overload of twenty per cent of its total output.

The commutator serves to illustrate the class and size of work being turned out from the Westinghouse works, now that the organization has become settled into definite operation. The development of this large undertaking will be watched



COMMUTATOR FOR 1,800-KILOWATT GENERATOR.

with considerable interest during the next few years, especially as some of the largest schemes for power distribution and railway operation are passing through the company's hands.

The escalator at the Twenty-third street station of the Sixth Avenue Elevated Railroad, New York city, which was shut down recently, has now resumed regular operation. Some time ago the motor driving the escalator was connected to take current from the third rail. It was found, however, that the voltage fluctuates over a considerably wider range than had been anticipated, and the shutdown was necessary in order that alterations might be made in the motor to secure better speed regulation. It is stated that during the interval in which the electrical changes were in progress the receipts of the station showed a marked falling off.

New Type Induction Motors.

The Stanley Electric Manufacturing Company, Pittsfield, Mass., is placing on the market a comprehensive line of induction motors which, along with its line of high-grade alternating-current apparatus, it recommends as being of the usual "S. K. C." standard. As the conditions of operation for alternating-current motors cover a wide range, the Stanley company has deemed it expedient to develop three distinct types, and not make one style answer for all service.

Fig. 1 shows the type A induction motor with the armature or secondary removed, showing the field or primary winding and bearings in the end-frames. This is the most simple type of motor. The armature or secondary, which is shown in Fig. 2, is of the squirrel-cage type, and consists of straight copper bars laid in partly closed slots, with practically no insulation, and short-circuited by means of heavy end-rings, as may be seen in the illustration. Injury to the armature, either by heating or by mechanical displacement of the parts, is practically impossible, and the wear on the motor is reduced to that which takes place in the bearings. Owing to the great simplicity of armature construction, the type A motor is the most desirable where the conditions admit of its use, namely, where the motor is not required to start heavy loads, or where a large starting current will not injuriously affect the potential regulation of the system. It is possible to start the type A motor by simply closing the line switch, and this method is used with motors below five horse-power; but as the first rush of current, when so starting, amounts to several times the running current, it is advisable to use with the larger sizes of motors a device called a starting compensator, to reduce the voltage impressed upon the motor, and thus decrease the current taken.

The starting compensator consists of a single-coil transformer in each phase of the circuit, with taps brought out at various points of the winding, in order that a number of potentials may be obtained. The compensator is provided with a double-throw oil switch, by means of which, after starting, the coils are cut out and the full voltage of the line applied to the motor. Fig. 3 shows diagrammatically the construction of the compensator, and the method of connecting it to the line and to the motor.

The point at which the compensator should be connected will depend upon the torque which the motor must develop in starting. Compensators connected to the first tap in the winding are furnished so as to give the minimum voltage, and therefore the least current. Should the torque thus developed be unequal to that necessary, a proper adjustment of the connections of the compensator to secure a higher potential can be readily made.

Fig. 4 shows the type B induction motor. In this type the starting current is kept low by introducing starting resistance within the secondary circuit. This motor does not possess the same simplicity of construction as the type A motor, owing to the fact that the armature has a polar winding, and a device for varying the armature resistance is necessary. But it has the advantage that it will start a given load with a current materially less than that taken by the type A motor. The type B motor is so designed that, for a given torque, the starting current will not exceed the running current. This type is

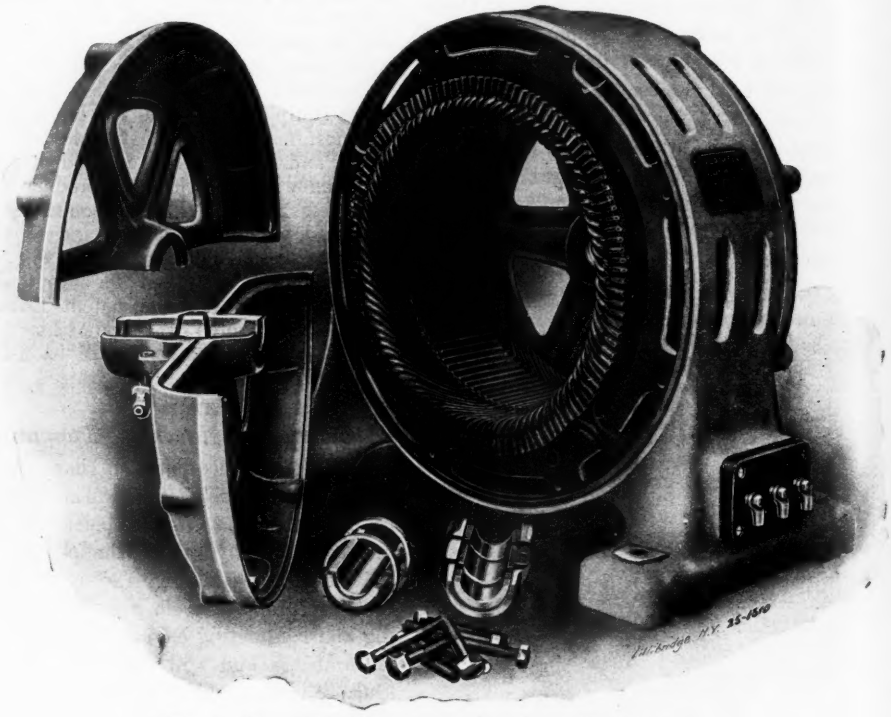


FIG. 1.—INDUCTION MOTOR WITH ARMATURE REMOVED.

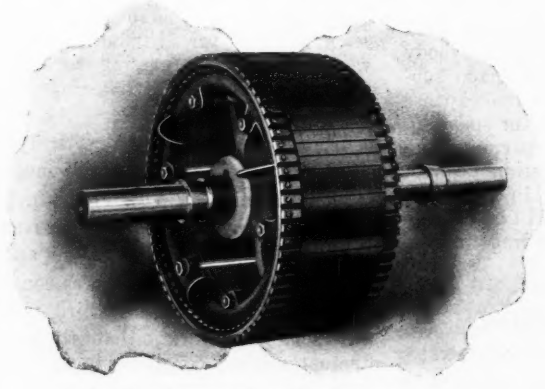


FIG. 2.—ARMATURE OR SECONDARY.

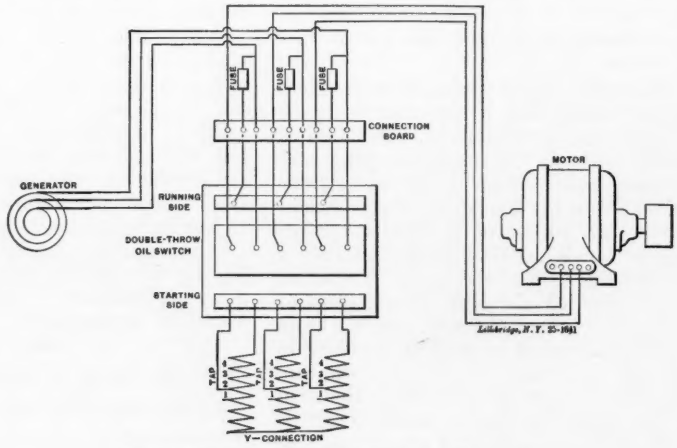


FIG. 3.—COMPENSATOR CONNECTIONS DIAGRAM.

therefore recommended by the company where the motor must start heavily loaded, and where a large current, such as the motor with short-circuited armature takes when starting at full load, would be objectionable.

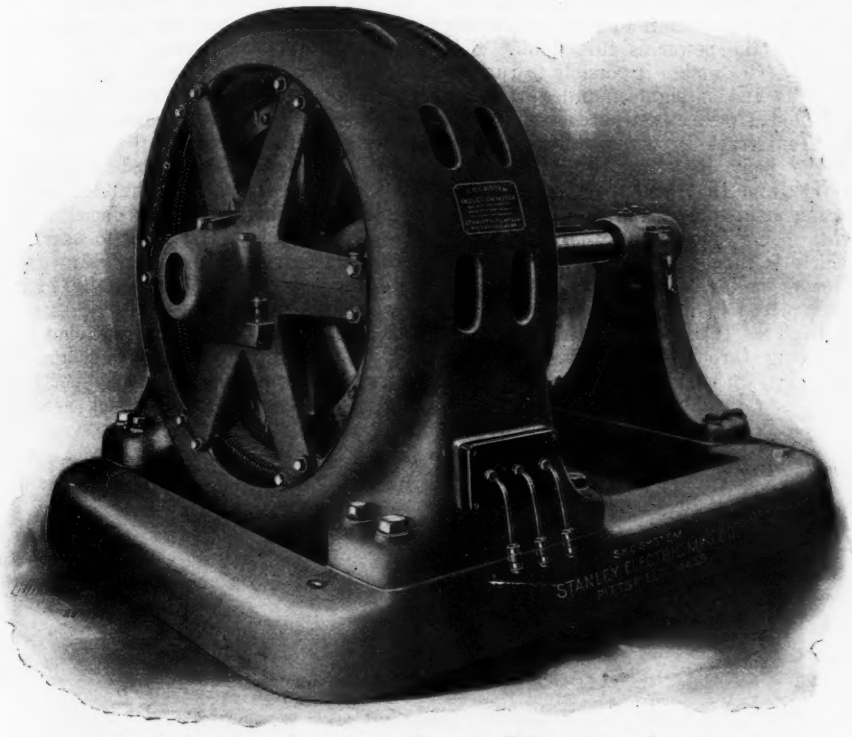


FIG. 4.—INDUCTION MOTOR WITH STARTING RESISTANCE IN SECONDARY.

The starting resistance is placed within the armature spider, and leads are brought out from several points of the resistance to a set of contacts parallel to the shaft. A lever on the outside of the motor operates a sliding collar, which is arranged to pass over the contacts so that the resistance on starting the motor can be short-circuited step by step. Fig. 5 shows the armature of the type B motor.

Fig. 6 shows the type C variable-speed induction motor. With this type of motor the armature winding is similar to that of type B. The leads from the windings are carried through a hollow shaft to the collector rings, by means of which connection is made with a suitable controller for cutting in and out the resistance external to the armature. In this way, with the rheostatic control, the desired speed variation is secured.

The manufacturer claims that these motors can develop a torque of at least 200 per cent of their normal full load. The temperature rise of a motor of either of the three types on a continuous run at full load will not exceed forty degrees centigrade. The speed of type A and type B motors varies but slightly from no load to full load, the variation not exceeding two per cent in the larger motors, and from five to six per cent in the smaller sizes. The standard induction motors are wound for frequencies of twenty-five, forty and sixty cycles. The standard potentials for the twenty-five-cycle motors are 220 volts for capacities under fifty horse-power, and 440 volts for capacities of fifty horse-power and above. The sixty-cycle motors are designed for the same potentials, and in addition, the regular line includes 2,080-volt motors, in capacities of fifty horse-power and above. The forty-cycle motors of all sizes are designed to operate at 550 volts.

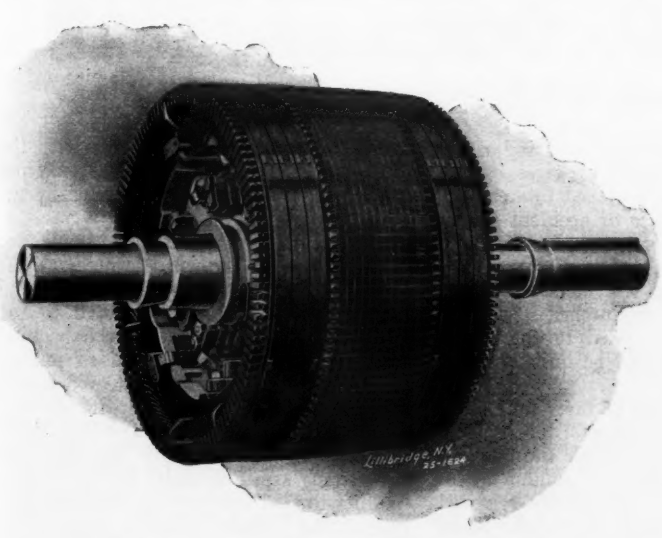


FIG. 5.—ARMATURE OF TYPE B INDUCTION MOTOR.

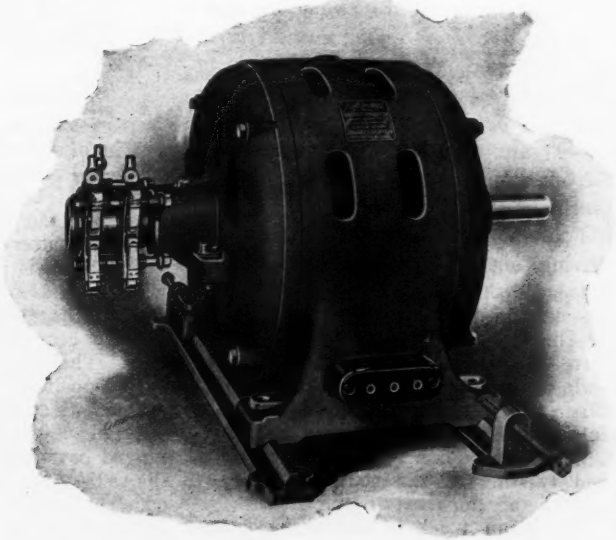


FIG. 6.—VARIABLE SPEED INDUCTION MOTOR.

Westinghouse Mining Locomotives for De Beer's Consolidated Mines.

Mule haulage is to be replaced by electric traction on the De Beer's mines, an order having just been placed with the British Westinghouse Electric and Manufacturing Company, Limited, for the supply of twelve mining locomotives of the Westinghouse type, with the requisite spare parts, etc. These locomotives have four wheels, each pair driven by a Westinghouse motor of ten-horse-power capacity at a conservative rating. They can thus develop a full load draw-bar pull of about 900 pounds, running at six to ten miles per hour on the level. The most interesting feature of these tractors is

that the gauge being very narrow—eighteen inches—the motors have to be mounted clear of the wheels. The motor pinion meshes in the ordinary way with an additional intermediate gear-wheel. The journals of the shaft carrying this gear-wheel run in boxes working in pedestals over the main journal boxes of the locomotives and rigidly connected to them. Thus the locomotive frame, which is supported on springs in the usual manner, is free to rise and fall on the axles and without disengaging the gears. The motors are hung on the shafts of the intermediate gear as if these were the ordinary wheel axles, and the usual "nose" suspension is employed. These locomotives are built to last, both mechanical and electrical parts being of very strong, workmanlike construction.

Columbia Electric Five-Ton Truck with Four-Motor Drive and Electrical Steering.

The new Columbia electric five-ton truck, made by the Electrical Vehicle Company, of Hartford, Ct., presents marked advances over large self-propelled vehicles of previous types, in that it exemplifies the first commercially successful attempt to apply power to all four wheels and to steer by other than manual power. The general lines of the construction of the vehicle proper follow quite closely standard horse truck construction of the well-known "New York gear" type. The large fifth wheel at the front permits the front axle and wheels to be swung at right angles to the body, giving a short turning circle and permitting the vehicle to be turned around in a space which is practically of its own length. All four wheels are alike and of the standard Sarven type, mounted on large roller bearings.

Four powerful motors are used for driving, one for each wheel. These are suspended directly from the body of the vehicle, transmitting power to the wheels by heavy roller chains. The wheel sprockets are bolted directly to the spoke, giving a simple but strong construction. Chain adjustment is provided by a powerful strut between the axle and the motor. This is so made as to allow for working and twisting of the body without any twist being imparted to the strut.

The front truck is steered by means of an electric motor. A large, broad-faced steering sector is carried by the truck. This sector meshes with a large pinion at the lower end of a short, thick vertical shaft, at the upper end of which is a worm-gear driven by a worm on a short shaft which can be clutched to the steering motor or not as desired. This arrangement affords a rigid back-lock, holding the wheels securely wherever the motor leaves them. In order to give perfect steadiness of steering, especially when coasting or when little power is required, a solenoid-released brake is put on the armature shaft to stop its rotating instantly the power is turned off. This simple device makes it possible to run the truck as fast as eighteen miles per hour and hold a perfectly true course. When the front truck is swung at right angles to the body it automatically cuts the power from the rear wheel motors, this arrangement preventing the front tires from being shoved sidewise when the vehicle is turned in a short circle. The steering motor is controlled by a short tiller placed immediately above the main controller. It is so adjusted that if it is swung through, say, fifteen degrees, the front truck swings through the same angle and then comes to rest. The direction of the tiller is always indicative of the direction of the progress of the vehicle. Means are provided to steer the truck by hand in case of accident to the motor or battery.

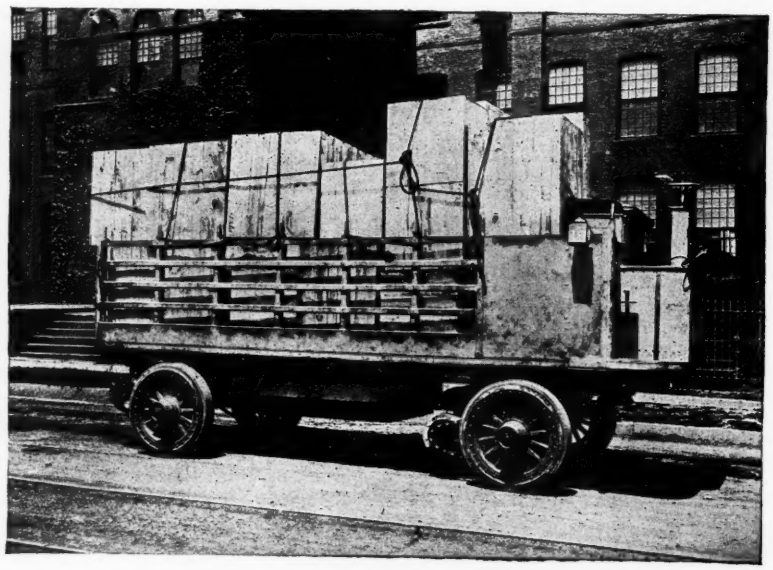
The truck is provided with a powerful winch operated by the steering motor when it has been unclutched from the steering gear and coupled to the clutch gear. This change can be quickly made by the operator.

The battery consists of forty-four exide cells of 280-ampere-hours capacity, arranged in a tray hung below the body by the well-known exclusive Columbia method. The battery can be readily removed by one man, although it weighs 3,500 pounds. A new method of battery suspension from three points has been introduced in this vehicle. With so large a truck, having a platform approximating sixteen feet by six feet in dimensions, it is naturally difficult to keep it perfectly flat at all times when it is in service, and by means of this suspension all warping and twisting of the battery is eliminated, which could not be the case if it were suspended from four points. The usual Columbia automatic contacts are used on the tray, simplifying the work of loading and unloading batteries.

The controller is of the standard Columbia vertical pattern, giving four speeds forward, an electric brake and three reverse speeds. The electric brake works on all four wheels and thus prevents skidding.

A powerful foot-operated expanding brake works directly on the rear wheel sprockets. This is a wood-faced brake arranged for easy adjustment to wear.

The largest solid tires made are used, and, as power is applied equally to all four wheels, not only is the driving strain per tire reduced fifty per cent, but the actual weight carried per tire is greatly reduced, inasmuch as only fifty per cent of the total weight of the truck need be supported on each axle, whereas with the two-motor drive from sixty to seventy per cent of the weight must be carried by the driving axle.



FIVE-TON ELECTRIC TRUCK—FOUR-MOTOR DRIVE, AND ELECTRICALLY STEERED.

This truck is especially designed for heavy traffic in crowded centres. The fact that it can be swung entirely around in its own length in from five to ten seconds does away with all the backing and filling which has proved so tedious to operators of heavy hand-steered trucks and which involves great wear on tires and mechanism. The four-wheel drive reduces the dead load per tire and cuts the driving strain in half; it also reduces liability to skid and greatly simplifies control of the vehicle under a heavy load. The matter of accessibility has been carefully attended to and all working parts, including motor, commutators and bearings, can quickly be got at for cleaning and oiling, adjustment and repairs.

The Electric Vehicle Company has several orders on hand for these new vehicles, two of which have been completed.

CURRENT ELECTRICAL NEWS

DOMESTIC AND EXPORT.

NEW CANADIAN WESTINGHOUSE COMPANY INCORPORATED—The Canadian Westinghouse Company has been incorporated by George Westinghouse, manufacturer, Pittsburg; Henry Herman Westinghouse, manufacturer, New York; George Carson Smith, capitalist, Pittsburg; Frank Hendrickson Taylor, Pittsburg; Loyall Allen Osborne, manufacturer, Pittsburg; Thomas Ahearn, manufacturer; Warren Young Soper, manufacturer, Ottawa and Paul Judson Myler, manufacturer, Hamilton.

CHICAGO TRACTION IMPROVEMENTS—Judge Peter S. Grosscup has taken official cognizance of the arguments recently made before him in respect to the ninety-nine-year claim, instructing the receivers of the Union Traction Company, of Chicago, to suffer no interference with the company's rights in Chicago streets. The Court hands down instructions to the receivers, declaring that the situation invites a settlement of the problem and pledges the Court's support; and the Court orders the sum of $580,000 expended on immediate improvements, including the purchase of additional cars and electrifying of parts of the cable system.

NEW PENNSYLVANIA-OHIO TROLLEY SYSTEM—It is announced that a large electric railway system is to be built between Avalon and Freedom, in the Ohio Valley. This is said to be the project of officials of the Pennsylvania Railroad. It is thought that because of the recent location of large industries at Leetsdale and Ambridge the building of a street railway system is necessary. While it is alleged that the steam railroad company has opposed the introduction of trolley lines into the Sewickley Valley, it is now prepared to withdraw any opposition, and will use its influence toward securing the construction of an electric street railway, provided that it is of up-to-date construction and operated so as to assist in building up the community through which it will pass.

MEXICAN POWER SCHEME—The Mexican Light and Power Company, Limited, whose New York offices are in the Columbia Building, 29 Broadway, is about to let contracts for the initial equipment for its plant at Necaxa, from which place power is to be transmitted to Mexico City, some nineteen miles distant. The first installation will be of some 28,000 horse-power, which will be generated by four 7,000-horse-power water turbines, direct-connected to generators of 5,000 kilowatts each. The available head is 725 feet. The average flow of water is at the rate of six cubic metres. In the winter and dry season it averages four cubic metres. The equipment will operate at 300 revolutions per minute. Mr. James Ross, of Toronto, is president of the company. Mr. F. S. Pearson is vice-president of the company, and is also chief electrical expert.

ILLINOIS TROLLEY SYSTEMS—Projects for connecting the principal cities of Illinois by an electric railway system are receiving prominent attention. It is estimated that within the next five years $5,000,000 will be expended in the construction of these lines, most of which will be constructed in central Illinois, the northern portion being pretty well supplied. Unless there is an unexpected hitch it will be possible within the next five years to travel from St. Louis, Mo., to Chicago, Ill., by trolley, and to visit every city of importance in the state by the same means. The principal system will be known as the W. H. Knight, which includes a line forty miles in length between Bloomington and Decautur; a line the same length between Bloomington and Peoria, and one of 150 miles between Springfield and Peoria, which circles around to take in Havana and Fulton County, with its principal cities. This company also proposes to construct a line to connect Springfield and Decatur. Another company will shortly commence operations between Bloomington and Joliet, to connect with the trolley line from the latter city to Chicago. The franchises from the principal towns and villages have been mostly secured and large amounts of stock subscribed.

NEW LINE OPEN BETWEEN JACKSON AND BATTLE CREEK, MICH.—The Jackson & Battle Creek Traction Company's line between these cities in the state of Michigan has been formally opened. This road is a section of one of the most important interurban railroads now being constructed in the country. The Jackson & Battle Creek Traction Company, whose lines have been placed in operation, passes through the cities of Jackson, Albion, Marshall and Battle Creek, a distance of forty-five miles. This company will, it is said, be consolidated in the near future with other sections now in operation and under construction through the cities and villages of Jackson, Grass Lake, Chelsea, Dexter, Ann Arbor and Plymouth to Detroit, forming a continuous line from Detroit to Battle Creek of 122 miles. These sections are to be completed and in operation under one management by January 1, 1904. As these different sections represent what is known as the Boland system, it is the purpose to extend this line west, ultimately to Chicago, making a total length of line of 285 miles. The entire road will be operated with a third-rail system on private right of way outside of the villages and cities, where the trolley will be used on a steam railway road-bed.

THE LARAMIE RIVER, WYO., TO BE THE SITE OF A NEW POWER PLANT—A syndicate of eastern capitalists has just been organized for the development and operation of electric power from the waters of the Big and Little Laramie rivers in the vicinity of Laramie City, Wyo. The syndicate's offices will be in Toledo, Ohio, with R. St. John as president and general manager, and Frank Smith as local superintendent, with headquarters at Jelm, Wyo. The electric generating station will utilize the flow of the Big and Little Laramie rivers and their tributaries. The cañon of the Big Laramie River has, just above the mining town of Jelm, a fall of eighty feet within a distance of one mile, while one mile below Jelm a second cañon of the same stream has a fall of 100 feet in one and one-half miles, the Big Laramie carrying at low water 400 cubic feet of water per second. On the south fork of the Little Laramie River, six miles north of Jelm, is a fall of 200 feet in one mile. Six miles farther north, the middle fork has a 250-foot fall in one-half mile; while six miles further northward the north fork of the Little Laramie River and Liberty Creek each offers a fall to the mile of over 200 feet. It is proposed by the Toledo syndicate to concentrate all of these water powers at a central distributing station, to be located either at Jelm or Pollock. The estimated cost of the power plant and building is about $1,000,000. The initial development of the electric plant will reach 5,000 horse-power, with the object of furnishing light and current for motors to the cities of Laramie, Cheyenne, Fort Collins, Rawlins, Saratoga and Encampment, with an eventual distribution to Steamboat Springs and to Greeley, and to all the towns on the Colorado & Southern between Fort Collins and Denver.

TELEPHONE AND TELEGRAPH.

MERRILL, WIS.—The Merrill Telephone Company has increased its stock from $10,000 to $25,000.

LINCOLN, NEB.—The Nebraska Telephone Company will make improvements to its local plant at a cost of $10,000.

DAWSONVILLE, GA.—The Bell Telephone Company intends putting up a line to Gainesville, and also a line from Dahlonega to Dawsonville.

HARRISBURG, PA.—The United Telephone Company has absorbed the Enterprise Telephone Company, an independent service in eastern Lancaster County.

WALTON, N. Y.—A local telephone company has been organized here with the following officers: J. S. Gillet, A. Owens, C. Liddle, W. C. Hulbert, G. Keeler and others.

ST. LOUIS, MO.—The Armory & Tupelo Telephone Company has filed articles of incorporation with a capital of $10,000. The incorporators are L. B. Camp and R. E. Camp.

OMAHA, NEB.—The stockholders of the York Telephone Com-

pany held a meeting recently for the purpose of increasing the capital stock of the company from $50,000 to $500,000.

MACON, MISS.—The Cumberland Telephone Company is to become the owner of the Laurel Telephone Company, of Laurel, Miss., which has a system in that city and in Ellisville.

GERMANTOWN, OHIO—The Independent Telephone Company has purchased the Bailey and Flinchpach lines which run west from this place, and will extend the line to Winchester.

ST. LOUIS, MO.—The Bluff City Telephone Company has decided to increase its capital, and will lay a cable across the Mississippi River at Hannibal, to connect with the Illinois lines.

PHOENIX, R. I.—Work on the construction of the lines of the Coventry Telephone Company has been commenced. The officers of this company are J. H. Hill, J. H. Hill, Jr., F. G. Bates and J. S. Carpenter.

DALLAS, TEX.—The McKinney Telephone Company has been organized and succeeds the Southwestern company at McKinney. The officers are J. E. Farnsworth, J. Shanne and W. R. Faught, with a capital of $30,000.

RICHMOND, VA.—A charter has been granted to the Asheville Telephone and Telegraph Company, with a capital of $300,000, and incorporators are as follows: C. R. Craig, W. S. Proctor, F. Carter, W. T. Gentry and H. Chipley.

LOS ANGELES, CAL.—The Santa Ana Home Telephone and Telegraph Company has filed amended articles of agreement, with a capital stock of $100,000. The directors are F. F. Graves, F. W. Watcher, J. Van Liew, C. L. Zahm and A. Wright.

TERRE HAUTE, IND.—The Citizens' Telephone Company, of West Terre Haute, will install a switchboard and connect with the Citizens' exchange at Terre Haute. The new concern has a capital of $5,000, with F. P. Silbey, A. F. Miller and T. Posolt as incorporators.

NEW INCORPORATIONS.

COLUMBUS, OHIO—Scott Telephone Company. $5,000.

HARRISON, ARK.—Reick Telephone Company. $10,000.

PIERRE, S. D.—Enterprise Telephone Company. $10,000.

HARRISBURG. PA.—Annville Electric Light Company. $10,000.

NASHVILLE, TENN.—Nashville Railway and Light Company. $6,500,000.

MARLTON, N. J.—The Marlton Light, Heat and Power Company. $10,000.

WATSEKA, ILL.—Watseka Home Telephone Company. $20,000. Incorporators: J. E. Bundy, J. A. Bundy, H. M. Fisk.

OWOSSO, MICH.—The Laingsburg Telephone Company. $25,000. Incorporators: R. Simpson, W. Simpson and J. L. Hisey.

AUGUSTA, ME.—Southwestern Land and Power Company. $1,500,000. Incorporators: F. L. Dutton and M. H. Simmons.

SPRINGFIELD, ILL.—Kewanee Home Telephone Company. $125,000. Incorporators: J. L. Dunn, M. C. Shoemaker and C. K. Ladd.

LYNCHBURG, VA.—The Elba Telephone Company. $5,000. Incorporators: R. T. Ramsey, T. C. Creasy, E. B. Fitzgerald, W. O. Smith and J. R. Glenn.

BEAUMONT, TEX.—Beaumont Light and Power Company. $600,000. Incorporators: W. A. Myrick, Russell Myrick, Horace Myrick and Walter J. Crawford.

FAYETTEVILLE, VA.—The Fayetteville and Electric Company. $33,000. Incorporators: W. A. McKenney, of Washington, D. C.; W. H. Basley, of Baltimore, and others.

BROOKLYN, N. Y.—Tocula Electric Light and Power Company. $300,000. Directors: David H. Valentine, Clinton L. Rossiter, Timothy S. Williams and Henry Seibert.

INDIANAPOLIS, IND.—The Terre Haute Electric Traction Company. $3,000,000. Directors: Ray G. Jenckes, Buena V. Marshall, Bertie McCormick, S. C. McKeen, G. F. Wells, Finley A. McNutt and Allen H. Donham.

ELECTRIC LIGHTING.

EDWARDSVILLE, ILL.—The city council has passed an ordinance granting a seventy-year franchise to the Edwardsville Electric Light and Power Company.

ELDORA, IOWA—The Eldora Electric Light and Heating Company's plant has been sold to Ferris Brothers, of Monmouth, Ill., by its owner, William S. Potter. It is said that the consideration was $40,000.

MEXICO, MO.—A company composed of S. M. Locke, president; J. W. Woolridge, vice-president; F. A. Morris, secretary and treasurer, and E. R. Locke has purchased the Mexico Electric Light Company's plant from Thomas Waddell, Harry Rubey and W. E. McCully, of Macon city, for a price in the neighborhood of $35,000.

NEWARK, N. J.—The board of works has awarded a five-year contract for street lighting to the United Electric Company for the lighting of the city streets. The contract is to continue in force for five years, and the price charged per lamp is $95. The city now uses 1,860 lamps, making the total cost more than $176,000 per year.

RIVERSIDE, CAL.—Corona is to have an up-to-date lighting plant. Franchises have been granted by the city trustees to the Corona Gas and Electric Company, capitalized at $50,000, and the work will be begun at once. The officers of the company are M. W. Findley, president; F. P. Cooper, vice-president; M. Terpening, treasurer; A. F. Le Gaye, secretary.

HOUSTON, TEX.—The Houston Electric Company has decided to expend about $100,000 in improvements upon its power-house, the work to be commenced at once. The effect of these improvements will be to increase the capacity of the plant almost twofold, and provide for the handling of any amount of business in any emergency. In connection with this increased output, it is said that the Harrisburg line is a certainty, and that the improvements are for the purpose of meeting this increased strain on power, as well as for other extensions which are to be built next year. The Harrisburg road will be commenced early next year. High-speed electric cars will be operated between Houston and Harrisburg.

ELECTRIC RAILWAYS.

DES MOINES, IOWA—An electric road will be built from Council Bluffs to Rockport, Mo.

TRENTON, N. J.—The Yardley and Newtown branch of the New Jersey & Pennsylvania Company's road has been opened, bringing Newtown into direct connection with Trenton. The distance is twelve miles.

MATTOON, ILL.—The capital stock of the Mattoon Street Railway Company has been increased from $100,000 to $500,000, and work on the interurban road between this city and Charleston will begin at once.

JAMESTOWN, N. Y.—The New York railroad commissioners have granted the application of the Chautauqua Traction Company, and work on the proposed street railway from Lakewood to Mayville will be begun as soon as possible.

HARRISBURG, PA.—A charter has been issued to the Wilkinsburg, Turtle Creek & East Pittsburg Railway, with a capital of $36,000, to build six miles of road in Allegheny County. The road will extend from Wilkensburg to Turtle Creek.

EXETER, N. H.—A mortgage deed of trust given by the Portsmouth, Dover & York Street Railway to the State Street Trust Company, of Boston, of all its property, rights and franchises, to secure an issue of $650,000 bonds, has been recorded.

DAYTON, OHIO—Work has been begun on the Franklin & Lebanon traction line, which will be about eleven miles in length, and which is backed entirely by local capital. Private rights of way and franchises have been secured by the entire route.

ST. JOSEPH, MO.—It is stated that the new electric road to be built between Kansas City and St. Joseph, touching at Atchison, Parkville and other points along the route, is to be a St. Joseph enterprise primarily, and that the name of the company will be the St. Joseph, Atchison & Kansas City Railway Company.

ELECTRICAL SECURITIES.

Although it was the general opinion at the close of last week that securities had reached their lowest levels, still further declines have been evident during the week just closed which have carried securities to new low levels for the year, and, in some cases, to the lowest point in many years. Some slight improvement was evident the latter part of the week, though it is evident that the bear interests are still active. The money situation and outlook promises to be the chief factor in stock market conditions for the balance of the year. Although no stringency is expected at the present time, opinions are very conservative as to the outlook in the fall.

Railroad earnings are very large, and general trade activity continues unabated. Crop reports are, in general, very favorable. it being stated that the agricultural outlook is even better at the present time than as shown in the last government report. If the harvest turns out as expected there is no doubt that the general trade of the country will be greatly stimulated and conditions materially improved.

ELECTRICAL SECURITIES FOR THE WEEK ENDING JULY 18.

New York:	*Closing.*
Brooklyn Rapid Transit	51⅛
Consolidated Gas	185
General Electric	165½
Kings County Electric	200
Manhattan Elevated	133
Metropolitan Street Railway	118½
New York & New Jersey Telephone	154
Westinghouse Manufacturing Company	190
Boston:	*Closing.*
American Telephone and Telegraph	132
Edison Electric Illuminating	242
Massachusetts Electric	82
New England Telephone	123
Western Telephone & Telegraph preferred	85
Philadelphia:	*Closing.*
Electric Company of America	8¾
Electric Storage Battery common	54
Electric Storage Battery preferred	54
Philadelphia Electric	5⅞
Union Traction	44¾
United Gas Improvement	84
Chicago:	*Closing.*
Chicago Telephone	120
Chicago Edison Light	144
Metropolitan Elevated preferred	65
National Carbon common	23
National Carbon preferred	94
Union Traction common	4
Union Traction preferred	32

PERSONAL MENTION.

MR. ADOLPH M. BARRON, president of the New Albany, Ind., Waterworks Company, and a consulting engineer who has been identified with a number of electric lighting and water companies in the Middle West, has moved from South Bend to Indianapolis, where he will reside.

MR. G. M. GEST, the well-known conduit contractor, was a visitor to the East last week, looking up a number of his contracts in this territory. Mr. Gest reports a very busy season just closed, and anticipates a still greater demand for subway construction and material during the closing summer months and the early fall season.

MR. AZA M. MATTICE, who for several years has been chief engineer of the Westinghouse Electric and Manufacturing Company, has been appointed chief engineer of the Westinghouse Machine Company. He will, however, retain his connection in a consulting capacity with the former company. Mr. Mattice will be succeeded in his duties by Mr. B. G. Lamme, who is appointed to this position with the title of acting chief engineer.

MR. GEORGE H. GIBSON has resigned as manager of the advertising and publication department of the B. F. Sturtevant Company, Boston, Mass., to accept an appointment with the International Steam Pump Company, having offices at 114-118 Liberty street, New York city. Mr. Gibson was formerly connected with the Westinghouse Companies' Publishing Department, of Pittsburg, Pa., and was for two years a member of the editorial staff of the *Engineering News*, New York city.

MR. F. C. MOTT, who for some time past has been associated with Mr. G. M. Gest, the conduit contractor, will be in charge of the new office in New York city which has been opened by the American Conduit Company, manufacturer of electrolysis-proof bitumenized fibre conduit. This office is in addition to those which the company operates in Philadelphia, Chicago and Los Angeles. The demand for this material during the past season is stated to have run into many millions of feet.

MR. WILLIAM D. SARGENT, vice-president of the New York & New Jersey Telephone Company, has recovered from a severe cold that confined him to his home for several days. Mr. and Mrs. Sargent are spending the summer at their beautiful Long Island home at Arverne-by-the-Sea, where one of the chief attractions is the daily concert by Theodor Gordohn, the talented young Russian director and composer. These concerts are given at the Arverne Hotel and the Casino, and attract the keenest interest of lovers of classical as well as popular music, thus presented by a master in his profession.

PROFESSOR HENRY S. CARHART, professor of physics at the University of Michigan, Ann Arbor, Mich., delivered a lecture on July 3 before the summer school of that institution, upon "Electrical Oscillations." Professor Carhart introduced his lecture by an explanation of the meaning of the nodes and antinodes of open and closed organ pipes. He then passed to electrical circuits, showing how these could be tuned with respect to each other. When an antenna was connected to one of these oscillating electrical circuits, the nodes and antinodes could be shown by means of a Geissler tube, when brought into the region of the oscillating circuit.

OBITUARY NOTICES.

MR. LUTHER STIERINGER died at Pasadena, Cal., of lung trouble, Friday, July 17, at the age of fifty-four years. His remains will be cremated and the ashes deposited alongside of those of his wife on Long Island. He leaves no family. Mr. Stieringer was very widely known in the electrical field, having been identified with it since the earliest days of electric lighting. He was particularly successful in the work of electric light decoration, and his services were in demand where large artistic effects were desired. He was associated with Edison in the early years of electric lighting, and was identified with the World's Fair at Chicago, the Pan-American Exposition and other expositions of this country. Mr. Stieringer was awarded early this year by the Franklin Institute the John Scott Legacy Premium and Medal for "Improvements in the Art of Electric Illumination." Although the deceased had been informed of this award, he had never seen the medal, as it is still in the engravers' hands.

MR. THOMAS CHALMERS, father of W. J. Chalmers, chairman of the executive committee of the Allis-Chalmers Company, died on July 13, and was buried on Thursday, July 16. Thomas Chalmers was the founder of the firm of Frazer & Chalmers, which firm was recognized as one of the world's largest producers of mining machinery. Mr. Chalmers was born in Dronley, near Dundee, Scotland, June 14, 1816. At the age of fourteen he was apprenticed to a Dundee machinery firm to learn the trade of machinist, which he followed in all its branches in Scotland and England for thirteen years. On July 2, 1840, he was married to Janet Telfer, of Greenock, Scotland. Mr. and Mrs. Chalmers came to America in 1843 and settled in a farming site between Joliet and Lockport, Ill. Mr. Chalmers built Chicago's first waterworks, and a study of his career would be parallel with the history of the industrial growth of Chicago, Ill. In 1855, with Mr. P. W. Gates and Messrs. E. S. Warner, A. G. Warner and David R. Frazer, Mr. Chalmers formed the firm of Gates, Warner, Chalmers & Frazer, which was succeeded in 1857 by the Eagle Works Manufacturing Company. In the winter of 1871-1872 this corporation was dissolved, and with Mr. Frazer, Robert Anthony and David Marchant, Mr. Chalmers formed the firm of Frazer & Chalmers. Two years ago this company, with three others, was merged into the Allis-Chalmers Company, and Mr. Chalmers, Sr., withdrew from active participation in its management.

INDUSTRIAL ITEMS.

THE STROMBERG-CARLSON TELEPHONE MANUFACTURING COMPANY, Rochester, N. Y., and Chicago, Ill., has recently sold a special type despatcher's desk with telephones to the Interurban Railway and Terminal Company, of Cincinnati.

THE ALPHADUCT MANUFACTURING COMPANY, New York and Chicago, distributed a most unique souvenir at the recent Contractors' convention at Detroit, in the form of a pipe with an amber stem, the bowl of which was of "Alphaduct" conduit with silver trimmings.

THE CROCKER-WHEELER COMPANY, Ampere, N. J., is distributing a handsomely printed pamphlet descriptive of the equipment of a railway shop. This portrays the new locomotive and car shops of the Lake Shore & Michigan Southern Railway, at Collingswood, Ohio, which are equipped with the Crocker-Wheeler motor-driven apparatus.

THE AUTO DEVICE MANUFACTURING COMPANY, 79 Dearborn street, Chicago, Ill., is placing on the market an auto switch for gas engines. This may be either for a touch-spark or a jump spark system of ignition. The company has published some interesting literature on this subject, which it will be pleased to send upon request.

THE WYCKOFF PIPE AND CREOSOTING COMPANY, Stamford, Ct., manufacturer of creosoted conduits for underground wires and cables, poles, cross-arms, railroad ties, wharf and bridge timbers, etc., has issued a new catalogue which tells a great deal about the processing of timber with dead oil of coal tar. This company has been more than ordinarily successful with this material, and its literature is worth preserving.

THE CONNECTICUT TELEPHONE AND ELECTRIC COMPANY, Meriden, Ct., has printed another issue of its new catalogue, and this will be mailed on request. This company has just purchased a new building to enlarge its capacity, which is made necessary by the increasing demand for its apparatus. The company has effected a number of new and valuable improvements in its apparatus, and will be pleased to describe these on request.

THE COLONIAL SIGN COMPANY, Akron, Ohio, is the manufacturer of an attractive sign device which is unique in design and of durable construction. The patents cover a concave letter of such a form that it will reflect the light in parallel rays, enabling the sign to be read from a great distance and at almost any angle. The letters are constructed of porcelain, and are easily kept clean. Where colors are used, the colors are burned in so that they are permanent.

THE ELBLIGHT COMPANY OF AMERICA made a very elaborate display of its lighting system at the exhibition given in Detroit in connection with the meeting of the National Electrical Contractors' Association. A portion of the building was festooned with Elblight cables, covered with evergreens, and from the cables Elblight lamps were lighted. The company's booth was an artistic affair lighted with a myriad of small lamps. The whole effort was a demonstration of the rapidity with which the Elblight system may be put in place.

THE ELECTRIC STORAGE BATTERY COMPANY, Philadelphia, Pa., has, through Mr. A. B. Dupont, vice-president of the St. Louis Transit Company, closed a contract for the installation of a 3,000-kilowatt storage battery, to be used in the substation, with rotaries having a capacity of 6,000 kilowatts. The battery will regulate fluctuations and assist in caring for the morning and evening loads. The substation is in the centre of the city, and this installation is one of the extensions being made for the purpose of caring for increasing traffic.

THE JEFFREY MANUFACTURING COMPANY, Columbus, Ohio, is distributing its catalogue No. 19. This is descriptive of mining machinery, and describes and illustrates coal cutters and coal drills operated by electricity and compressed air; electric locomotives for mine and surface haulage, and complete electric plants for mining properties. Outside of the typographical and mechanical treatment, which is handsome in the extreme, the catalogue is a valuable addition to the literature on this subject. The book is very fully illustrated, and the text carefully outlines the function of the apparatus.

THE SWEDISH-AMERICAN TELEPHONE COMPANY, 88 and 92 West Jackson Boulevard, Chicago, Ill., has recently furnished complete exchange equipments to the following telephone companies: The Ney Telephone Company, Ney, Ohio; the Potosi Telephone Company, Potosi, Mo.; the Palo Telephone Company, Palo, Mich.; the Idaville Mutual Telephone Company, Idaville, Ind.; the Illiopolis Telephone Company, Illiopolis, Ill. The Swedish-American Company announces that the prospect for business was never better, and that it does not anticipate the usual slump in business during the summer months. The company's apparatus is more popular than ever.

THE CROUSE-HINDS ELECTRIC COMPANY, of Syracuse, N. Y., lighted a large portion of the exhibition recently given in connection with the National Electrical Contractors' convention at Detroit, using the "Norbitt quick-put-up" specialties. In the company's booth an artistic trade-mark had been worked out in colored incandescent lamps. In this booth "Norbitt" mouldings and conduit receptacles were shown on the oak railing. An aquarium had been arranged with gold-fish in which a "Norbitt" temporary decorative socket with a sixteen-candle-power lamp placed under the water showed the absolute water-proof qualities of the appliance. This company also exhibited switchboards and panel-boards.

THE EUREKA ELECTRIC COMPANY, Chicago, Ill., in its catalogue No. 23 describes a splendid line of telephone apparatus, including central energy instruments, series telephones, bridging telephones, tandem bridging telephones, complete portable desk sets, magneto series and bridging telephones, intercommunicating telephones, transmitters, receivers, five-bar bridging generators, lightning arresters, switch hooks, switchboards and numerous accessories. The illustrations and descriptive matter are supplemented by a number of diagrams of circuits, which are interesting and instructive. The catalogue is carefully indexed and well designed in every way.

THE JOSEPH DIXON CRUCIBLE COMPANY, Jersey City, N. J., is distributing a pamphlet describing the Dixon "Eterno" indelible pencil. This pencil writes black, and may be used for all manner of work requiring an ordinary lead pencil, but it also possesses the valuable feature of being a perfect copying pencil, making an indelible mark. While the pencil writes black, it copies purple, and it is stated by the company to possess the other valuable features which go to make the Dixon pencils so popular. Straight-grained Florida cedar and pure Ticonderoga graphite combine with the best aniline colors in a secret process to afford these qualities.

THE ARMOUR INSTITUTE OF TECHNOLOGY, Chicago, Ill., has ready its year book for 1903-1904. A number of excellent courses in mechanical engineering, electrical engineering, civil engineering, chemical engineering and architecture are offered, and the trustees are desirous of affording the students of this institution the very best training that a careful faculty can devise. A new course has recently been established which will be designated as a course in fire insurance protection engineering. This course has been commended by a number of prominent men, both from a commercial and from a scientific point of view. Mr. William E. Curtis, the celebrated writer, in a special article in the Chicago *Record-Herald*, of June 29, pays a high tribute to the conditions existing in the work of the correspondence instruction courses conducted by the Armour Institute.

THE LUNKENHEIMER COMPANY, Cincinnati, Ohio, manufacturer of brass and iron steam specialties and engineering appliances, tendered to its employés its forty-first annual outing at Woodsdale Island Park, on Saturday, July 18. Seven hundred employés and their families participated in the outing, about 2,000 people, including children, enjoying the different events. Everything was free, including transportation, refreshments, music, dancing, etc., the entire expense of the outing being paid by the company. Woodsdale Island Park is about thirty-one miles from Cincinnati, on the C., H. & D. Railway, and it required two sections of ten coaches each to carry the passengers. The events of the day were opened by a flag-raising ceremony and a concert by the First Regiment Band. Baseball games were held in the morning and afternoon, and a series of fourteen athletic events was conducted for valuable prizes.